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# Petroleum in Britain

CONSENSUS of geological opinion has long been opposed to the prospect of finding commercial oil-pools in England. Ever since the failure of war-time effort to locate petroleum resources (Hardstoft excepted as a modest memorial preserved from decay, by almost uncanny, albeit slender persistence), there has been nothing stirring in relevant geological knowledge of England to change such opinion. The last two decades have been productive of outstanding geological and oil-engineering achievements elsewhere, of progressive increase of knowledge of conditions governing the natural history and favourable loci of subterranean oil-pools; but they cannot by any stretch of proved fact or reasoned hypothesis be claimed as having sponsored hitherto unsuspected data to upset deep-rooted conviction in enlightened technical circles of Britain's unfortunate inability to reveal indigenous oil in industrial quantity.

Recurrent enterprise, of a highly speculative character as 'wild-catting' mostly is, from time to time has focused public attention on activities in Kent, Sussex and elsewhere. Fanned by the breeze of a good, though often ill-informed press, the flame of prophecy of discovery of petroleum in quantities sufficient to make Britain independent of foreign supplies spread rapidly, especially in 1933. Confirmation of predictions from extra-British sources was not lacking, any more than it was when the war-time oil-drive commenced; whatever success their efforts unquestionably merited in foreign lands, the impression was widespread that there was a certain ineptitude on the part of British oil geologists to understand their own territory, and to this extent carefully weighed opinions and published statements were ignored. The position developed, as inevitable, into one of first-class public importance. Geological discussion yielded gladly to political controversy on the situation, which culminated in the passing of the Petroleum Act in 1934.

Insofar as the Act goes, it is unquestionably a sound measure, providing as it does for organised and licensed development by the State, and a direct national interest in whatever may ultimately be found as petroleum. Its implications, however, were from the layman's point of view possibly not so sound, since the publicity given to the matter in Parliament and outside naturally suggested by inference, if not as inspired official opinion, that there did indeed exist possibilities of commercial oil deposits in England. This was certainly not the intention of the Act.

None the less, it did place a moral obligation on oil technologists in general and British oil companies in particular, to re-examine the whole question of possibilities and to consider a reasonable scheme whereby, so far as humanly possible, the doubt could be settled. What more natural than that one of our leading British oil companies should take the initiative and, in the same spirit of cautious enterprise characteristic of its operations elsewhere, formulate and put into practice a scheme of widespread testing of potentially favourable areas in southern and south-western England?

On March 30, the Anglo Iranian Oil Company, through its subsidiary, the D'Arcy Exploration Company, commenced drilling operations on the first test-well to be sunk under the provisions of the

1934 Act, at Paulsgrove, on the slopes of Portsdown Hill overlooking Portsmouth. The rig is of a modern rotary type, 135 feet high, with a loading capacity of 400 tons, and stated to be capable of drilling to a depth of nearly three miles.

In his opening speech at the ceremony of setting in motion these works, Sir John Cadman referred to the enterprise, which all hoped would be eventually of great national importance, as "first and foremost a business venture, based on scientific observation, and organized with all the elaboration of detail that engineering skill and experience can suggest". He referred to the exploration company "as adventurers into the unknown, where, in the language of the oilfield, 'only the drill can tell' ".

From the strictly geological point of view, we may anticipate the drill telling of the bold structure of the Portsdown anticline which forms the conspicuous chalk background to the historic city. It may tell, also, of a sequence of rocks of which British geologists familiar with southern England stratigraphy could make a fairly shrewd guess both as to character and disposition. It may do much to strengthen conceptions of the sub-Wealden structure. It will focus attention on Upper Jurassic possibilities, in particular the sorely tried and much over-rated Kimmeridge Clay. It will perhaps offer some explanation of the not far-distant natural gas and petrol smell of associated strata at Heathfield. It may even, in three miles of deep drilling, pierce totally unexpected and much older rock structures, including Carboniferous.

All this is reasonable. But let us not build too optimistically on the results in terms of oil. Rather let us hope for the unexpected and applaud the efforts now being made and the patriotism behind them. Should failure be the reward, which every British geologist, whatever may be his convictions, would doubly deplore in the interests both of science and the State, then may it be that science, in particular geology, may benefit lastingly by the knowledge thus made available, and possibly, as in the case of the sub-Wealden boring, industry benefit by discovery of a new mineral deposit, other than petroleum, of economic worth.

# Pre-nuptial Medical Examination

THOUGH vitamins and minerals are fashionable ingredients of well-informed and polite conversation, by most people reproduction is not mentioned: it is disturbing, even repulsive. Yet men and women do mate and reproduce, and the State which is beginning to regard the child as a liability will sooner or later be forced to exhibit a very lively interest both in the number and the quality of the children that are born to be fed, housed, educated and employed or not employed.

Pre-nuptial certificates are even now demanded in certain countries, though usually by them eugenic considerations are completely disregarded. In Turkey, for example, marriage is forbidden to persons affected with active venereal diseases, mental disease or leprosy; whilst the marriage of persons afflicted with advanced and transmissible tuberculosis is delayed for as long as a year. In Norway there is a somewhat similar law prohibiting the marriage of a syphilitic, but in the case of other venereal diseases, epilepsy and leprosy, the other party to the marriage must be informed, and both parties warned by a physician of the possible consequences of marriage. On the schedule used in connexion with these cases there are questions relating to consanguinity, and information concerning the prohibition of marriages of close relatives. In Germany certificates of health before marriage are demanded of those persons applying for marriage loans; and for these, fairly comprehensive details of the family and personal medical history are required.

In Great Britain, it may be remembered, Lord Kilmaine, in the House of Lords on November 14 of last year, moved a resolution favouring the compulsory exchange of health certificates before marriage. It was suggested that there should be four kinds of such certificates: (*a*) when both parties are perfectly fit to marry and to raise a family, (*b*) when the marriage should be delayed for 3–6 months, (*c*) which permitted marriage without parentage, and (*d*) which prohibited marriage altogether. Lord Kilmaine appeared to think that an actual medical examination in these cases was unnecessary, and that it would be enough if the two people concerned merely answered the questions of the physician concerning their general health and family history. As was to be expected,

the proposals met with well-merited and strenuous opposition, for, quite obviously, the responsibility that was to be placed upon the medical practitioner would have proved quite intolerable.

However, when such a proposal is aired in Parliament, it is safe to assume that it has been, in one form or another, under discussion by a considerable portion of the population for a decade or more. There is no doubt that the demand for information and advice concerning those physical and psychological abnormalities that militate against the success of marriage, and the wish to prevent the birth of hereditarily diseased or defective children, has been growing apace, and already a great deal is being done by private individuals and organisations to give such advice and to guide this wish by means of bureaux and clinics. Further, it is now the common view that the family doctor treats not only the illnesses of the present generation but also prescribes for the children yet to be conceived. But it is the case that not all family doctors are possessed of the knowledge and wisdom which constitute the only warranty for the giving of advice of this particular nature.

So the Eugenics Society is to be congratulated for having prepared a scheme of voluntary pre-nuptial health examinations which is meant to help the family doctor. It was decided that at the present time no good purpose could be served by advocating any scheme of compulsory examination for the reason that this simply would not work, since anyone who resented being thus examined could easily conceal or distort important facts; whereas if the examination were sought voluntarily and entered into in good faith by both parties, there would be no such concealment, and at the same time a great deal of help could be given and a great deal of very important information relating to human and social biology amassed. It is assumed that most conscientious and serious-minded people embarking on marriage want to feel assured that they are sound in mind and body, and that such of these who know that in their family histories there are defects and derangements which they have reason to think are hereditary, also want to make sure that the children that they propose to have shall not repeat such hereditary blunders.

The scheme is a purely voluntary one, and it is placed at the service of those who wish to take advantage of it. The parties concerned present themselves before their own doctor, who applies to the Eugenics Society for the appropriate schedule. This consists of three parts. The first two of these, which are concerned with the family history and the personal medical history of the applicant, are to be filled in by the applicant before the medical examination is undertaken. In the second part there is a special section dealing with sexual problems, and the answers given to the questions therein should permit the sympathetic physician to remove a great many barriers to a successful and happy marriage. Part 3 provides a most excellent guide for the doctor in his physical examination of the applicant. It is to be noted that the schedule is to be issued only to doctors, and it is in no sense a certificate. Nowhere in it is the doctor asked to certify that the applicant is fit or unfit either for marriage or procreation.

In order to help practitioners who are not well-informed in the field of human genetics, the Society has appointed a small board of specialists who may be consulted about problems of heredity. It is not stated to whom the doctor may turn for help in dealing with the marriage bureau kind of problem.

Without doubt the scheme is a most excellent one, not so much because, through its help, either the practitioner or the board of specialists will be able to offer compelling advice to any given individual or pair, but because it can, and probably will, encourage the development of a eugenic conscience (though probably only in the middle-class where such a conscience already exists), and furthermore because, if properly employed, it can be the means of adding greatly to our knowledge concerning the reasons for the success or otherwise of marriage in individual cases, and of the incidence and mode of inheritance of pathological characters in mankind. But two things must make the working of the scheme difficult. One is that exceedingly few medical men of the present generation know anything of sexual psycho-pathology or of the principles of genetics, and the other is that our knowledge of human genetics is exceedingly slight and most imperfect.

However, the project is a step in the right direction, right in the sense that it, a purely voluntary scheme devised by a private society, is undoubtedly an intelligent anticipation of what will be, in the not too distant future, a compulsory scheme backed by law. The State is bound, in its own interests, sooner or later to place its sentinels at the portals of birth, for it is by this route that most of our undesirables enter the realm.

# Heat a Mode of Motion: A Modern Version

**A Treatise on Heat**
(including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics). Being the second and revised edition of "A Text Book of Heat". By Prof. M. N. Saha and B. N. Srivastava. Second edition. Pp. xii + 815 + 2 plates. (Allahabad and Calcutta: The Indian Press, Ltd., 1935.) 27*s*.

THE authors of this book have written a most stimulating version of the old song "Heat a Mode of Motion", and written it, too, rather in the grand manner. Their arrangement of matter follows classical lines. Formal thermodynamics is not introduced until more than half-way through the book. Before that point is reached, there are excellent descriptive chapters on thermometry, calorimetry, production of low temperature, heat engines, gases, changes of state, elementary kinetic theory and other topics. These are all treated in a most pleasing broadly descriptive manner, with a temperature based on the perfect gas scale and an occasional forward reference to the second law where unavoidable. The ideas of hot and cold and heat are here quite properly treated as familiar primary concepts which need not be further analysed—quantities which we must set to work to measure precisely—and the kinetic interpretation of heat is brought in naturally in its right place. The chapter on heat engines seems to me to be exceptionally satisfactory for the elementary treatment that is intended, being practically without reference to entropy, and using merely a perfect gas Carnot cycle as standard. An exceedingly pleasing feature is the section on the Otto cycle gas or oil engine, the Diesel engine and steam turbines. The latter, however, are not given credit for the full overall efficiency that has recently been attained.

At this point there is a complete break, and we go back to the beginning again for a more rigorous formal treatment of the subject, starting with the first law of thermodynamics. This proceeds along the usual lines, but includes an excellent chapter on the thermodynamics of radiation, after which it leaves classical thermodynamics and ends with an elementary account of statistical mechanics and the contribution that this newer method can make to the general theory of heat. There are points in this exposition to which exception can be taken and these will be referred to later on—but as a whole the high level of the earlier part of the book is maintained. The treatment is never ponderous—the style is simple and easy to read (in short, good), and the whole monumental work of more than eight hundred pages forms an excellent not too elementary introduction for any serious student to the thermal properties of matter. For this purpose it is all to the good that the book is not a monograph, but makes more than one fresh start and provides in many places a number of alternative arguments.

We turn now to points of detail on which criticism is possible. In calculating the pressure exerted by an almost perfect gas on the wall of a containing vessel, the authors mention that the effect of collisions on the arrival of the right sort of molecules has not been taken into account, but that it is without effect on the result. This is of course true, but the explanation here offered is obscure, and it can be given much more clearly by using the ideas of the free path and associating all molecules with the volume element of the gas in which they suffered their last collision. This very simple physical idea is in fact not mentioned in the book, which is to be regretted, and here would have been an excellent opportunity for its presentation. In the same chapter, in discussing the energy of rotation of a molecule, this energy is expressed in the Eulerian form $\frac{1}{2}(I_1\omega_1^2 + I_2\omega_2^2 + I_3\omega_3^2)$, and it is inferred without further comment that as the average energy is $\frac{1}{2}kT$ per square term, the average energy of rotation is $3/2kT$ per molecule with three degrees of rotational freedom. But this theorem on average energy content is in general only proved for Hamiltonian co-ordinates, while $\omega_1$, $\omega_2$, $\omega_3$ are not velocities corresponding to any such co-ordinates. The proof here suggested therefore fails, though of course the result is true.

In another chapter, in discussing the equation of state of an imperfect gas, the old mistake is repeated of assuming that the excluded volume and cohesive forces can be discussed separately, and are additive corrections without effect on each other. To give van der Waals's original arguments for the sake of their historical interest is well enough, but it should then be pointed out firmly that the arguments and the results so obtained are *wrong*. One should not merely pass on to describe other lines of argument, such as the virial, as pure alternatives without critical comment.

The weakest feature of the book is the start of the chapters on formal thermodynamics. The whole subject has been magnificently introduced by the opening chapters, and when the new start

is made to pull the whole subject together into the laws of thermodynamics, something much more logical and formal seems to me to be called for. This of course is largely a matter of taste, and the authors are obviously acquainted with the sort of presentation here suggested, based on the work of Carathéodory and Born, and have no doubt deliberately discarded it. But it always seems to me to be a pity that so many presentations of thermodynamics should rush straight into the formal developments without any attempt to achieve the maximum logical simplicity in the foundations. The peculiar character and fundamental nature of the temperature as a variable in such presentations is entirely overlooked. A proper development of thermodynamics should, I am convinced, begin with the 'zeroeth' law of thermodynamics : *There exists a variable called the empirical temperature, which may be used in defining the state of any system having the property that it has the same value for all parts of a system in thermal equilibrium.* I am also convinced that, again following Carathéodory, thermodynamic functions and processes should so far as possible be defined in mechanical terms, and the number of new indefinables reduced to a minimum. No attempt is made to do this here. The tastes of the authors and the reviewer differ so widely on this point that it would be useless and indeed ungracious to elaborate these criticisms.

It will be sufficient to mention two more passages where the customary treatment adopted by the authors seems to fail. They introduce the first law in the form $\delta Q = dV + \delta W$, which is logically faulty, for the statement has to serve both as an existence theorem for $V$ and a definition of $\delta Q$, and physically incorrect, for the first law is really the existence of $V$ and is based on experiments such as Joule's in which $\delta Q$ always vanishes. Secondly, the authors claim to give a proof that $\delta S > 0$ in any material process, but their proof seems to me to be based only on a study of particular entropy functions and to be quite incapable of establishing the general principle involved, which must surely be taken, following Clausius, as one of our fundamental generalisations from experience, and not deducible from any less drastic hypothesis.

The same tendency to follow conventional treatments has led the authors in the statistical chapters, which are otherwise excellent, simple expositions of the elements of statistical mechanics, to an uncritical acceptance of the concept of absolute entropy. Whatever one's personal taste in the matter, it seems proper in a book of this sort to insist at least that the concept serves no essential purpose, and that every conceivable theorem in statistical thermodynamics that can be applied to any physical or chemical problem can be formulated without its help. This is not to deny that some workers may find the concept convenient in practice. The authors, however, leave the reader thinking that the evaluations of chemical constants and reaction isochore constants can only be made with the help of absolute entropy. Something of the same weakness is to be found, too, in the treatment of Boltzmann's hypothesis concerning the connexion between entropy and probability. The concept of absolute entropy and the 'improved' formulation of Boltzmann's hypothesis have been responsible for some of the most illogical and slipshod thinking that has ever disgraced the pages of scientific books and journals, and it is high time that greater precision should be insisted on. The present authors have in no way added to the old confusion. The charge is only that they have failed to take an excellent opportunity of reducing it, for the lack of a few sentences of judicious criticism to direct the reader's thoughts aright.

Turning now to minor points, I have already expressed my admiration for the style of the book, and this is in no way diminished by a number of sentences incorrectly constructed. Such mistakes as I have noticed never left the meaning in doubt, and add a pleasant flavour to the style rather than detract from it. But there are one or two poorly phrased definitions, such as those of $E_\lambda$ and $e_\lambda$, which might well be overhauled in the next edition. Again, in a work in this grand manner, the sudden introduction of abbreviations such as 'A.N.' jars on the reader, more particularly as it is, I think, undefined and apparently means the absolute zero of temperature, for which this Germanic abbreviation is quite inexcusable in an English text. Nor can I suffer gladly the misuse of the established phrase *partition function*, which has long been in common use as the equivalent (not a rendering) of the German *Zustandsumme*. It is always a matter of difficulty to coin good equivalents for scientific terms, but there is no need whatever to adopt the method of literal translation when it leads to awkward results, or of direct incorporation of the foreign word, so long as a simple, natural and reasonably expressive term is available, as is surely the case here. Would that it were always so, and that someone would coin a really good English equivalent for *Bremstrahlung* !

A word now on the printing. The book is well got up and an astonishing value for the price, and the formulæ in general are really well and intelligibly composed ; but in spite of this, the reader gets the feeling of a not really clear page. In looking into this more closely, it seems to be due to the rather large number of slightly smeared

or dirty letters, or actually broken letters on each page. In my copy I counted fourteen apparently broken letters on a page (p. 717) selected at random which should have been removed and replaced by perfect letters by a high-class professional reader. I only mention this because the general standard of the Indian Press Ltd. as shown in this book is already so high that one may obviously assume that they are themselves satisfied with nothing less than the best, and will probably wish to attend to this point more closely in future.

These remarks on typography lead naturally to the conclusion of this review. It is apparently mainly devoted to criticism, but only because the general standard of the treatise is so high that criticism of the points with which one disagrees seems worth while. One may confidently expect and heartily wish that it will be widely read and run rapidly through many editions. May I hope that in later versions some of what I find discords will have been removed? But I shall wish the book well in any event. R. H. F.

# A Science Anthology

**Readings from the Scientists:**
an Anthology. Selected and edited by J. Edward Mason. (The Scholar's Library.) Pp. x+309. (London: Macmillan and Co., Ltd., 1935.) 2*s*. 6*d*.

TO produce, in small compass, a readable, and varied, anthology of the literature of science is a difficult matter, and the editor is to be congratulated on the success of his effort. It were easier, and safer, to stick to the descriptive sciences, but the editor has taken his courage into his hands and has laid under contribution chemistry, geology, natural history, mechanics, exploration, astronomy, physics, science and art, and fiction. If we divide the selections in time, and regard the date of Ruskin's death as marking the close of an era (as indeed it does), we find that out of the 280 pages of text, 130 pages are allocated to the post-Ruskin period. Obviously the natural sciences bulk largely in the selection, and opinions will differ concerning the value of the eleven pages devoted to a selection from Einstein's "Relativity"—probably the majority of readers will get more fun out of the excerpts from "The Time Machine". But the balance has been very well kept—it is pleasant to meet again the friendly words of Gilbert White, Miller and Darwin; equally pleasant to read the newer story of the eel, to learn something of spinning tops and boomerangs, and to wander into space (four-dimensional) under the guidance of Jeans or Eddington.

All the sciences can tell remarkable and marvellous tales, and some of the most remarkable are concerned with things that have never happened. It would be a pleasant, and not unprofitable, task to compile an anthology of these marvels; indeed, such an anthology would not 'dedecorate' the "Scholar's Library". The natural sciences have their full share of such stories—tales of the frays between the gryphons and the Arimaspians; of the Anthropophagi and men whose heads do grow beneath their shoulders; of the Antichrist who, as was reported by the spies of the brotherhood of St. John, was born in 1623 near Babylon "of which child the mother is a very aged woman, of race unknown, called Fort-Juda; of the father nothing is known. The child is dusky, has pleasant mouth and eyes, teeth pointed like those of a cat; . . . the said child, incontinent on his birth, walked and talked perfectly well. . . . Our spies . . . add, that, on the occasion of his nativity there appeared marvellous signs in the heavens, for at full moon the sun lost its brightness, and was for some time obscured"—not to mention a swarm of flying serpents and a shower of precious stones.

What, too, of Gerarde, who thinks it "not impertinent to . . . end with one of the marvells of this land", an account of "certaine trees whereon do grow certaine shells of a white colour tending to russett, wherein are contained little living things, which shells in time of maturitie do open, and out of them do grow those little living creatures, which falling in the water do become fowles, which we call Barnakles, and in Lancashire tree-geese, but the others that do fall upon the land perish and come to nothing".

Of the lesser marvels which have found their way into the works of later authorities, stories concerning the hibernating habits of the swallow are not the least captivating. "Swallows certainly sleep all the winter. A number of them conglobulate together by flying round and round, and then all in a heap throw themselves under water, and lye in the bed of a river". Thus far Johnson, and, though Boswell is here, possibly, an inaccurate reporter—for 'conglobulate *together*' is scarcely Johnsonian—the sentence sums up the common

belief. And have we not further evidence contributed by that shadowy figure Mr. Steevens, A.S.S., who emerges from nothingness to tell us, in the *Annual Register* for 1781, how he picked up bunches of swallows from a pond and how the birds, revived, flew about the kitchen in the presence of the Reverend Doctor Pye. Mr. Steevens and the Reverend Doctor Pye play no great part in the drama of history, but we could more easily part with some more eminent figures.

The volume under review, we hasten to add, confines itself, with one definitely imaginative exception, to more sober happenings. It is fully annotated and admirably produced, and the publishers are to be congratulated on a notable addition to an interesting (and low-priced) series.

A. F.

# The British Coal Industry

**Report on the British Coal Industry;** a Survey of the Current Problems of the British Coal-Mining Industry and of the Distribution of Coal, with Proposals for Reorganisation. (P E P (Political and Economic Planning) Industries Group.) Pp. vi+214. (London: P E P, 1936.) 7*s*. 6*d*. net.

IN 1925 a Royal Commission, presided over by Sir Herbert Samuel, heard evidence and later published a report. Much has been written about the coal industry since, but the report of the industry now under review is the most comprehensive that has appeared in the last ten years. It is necessarily a long document because it contains evidence to substantiate the opinions expressed therein.

The three dominant features of the British coal mining industry outlined in the report are: (*a*) the absence of concentration of the country's output; (*b*) the improbability of a substantial increase in the demand for coal in the future; (*c*) the certainty that, even if there is any increase in the demand for coal, there will still remain a large number of miners with no prospect of re-employment in a coal mine, and a considerable number for whom under the present system only part-time employment will be available.

The report makes it clear that there is a number of redundant mines in Great Britain the lives of which are being prolonged by the policy of 'spreading the work', one of the results of the 'quota' system which came into being with the 1930 Act. The curtailment of output, in itself a necessary evil, was made applicable to every producing mine instead of concentrating all work at the more efficient mines, which to-day cannot work full time.

The plain fact is that an efficient coal mining industry in Great Britain implies an increase in permanent unemployment for the present mining community. Owing to technical improvements in coal utilisation and the growth of Continental production, the annual output of coal in Great Britain can never return to its pre-War dimensions. In addition, the increase in underground mechanisation has more than offset the increasing difficulties of mining. It will therefore be realised that the amount of work available for miners is bound to diminish.

As efficiency in mining goes hand in hand with concentration of work, 'spreading the work' is the wrong policy from the technical point of view, and concentration of the output at the more efficient mines, which will thus be able to work full time, means unemployment for a large number of men, for whose absorption into other industries adequate steps must be taken, or they must be catered for in some other way.

Such methods as the following are suggested: restriction of entry into the industry, pensions for all men of more than fifty-five years of age or the provision of alternative employment in the mining areas. *Per contra*, the miners, as a class, while admirable workmen, are not adaptable to other trades and the older men are disinclined to leave their own districts.

Except for the fact that the output of coal is being spread over too many mines the technical direction of the industry is excellent, and moreover the work is carried out more safely than in any other mining country. On the other hand, the control of the disposal of the output is definitely inadequate and the costs of distributing unnecessarily high.

The promise by the colliery proprietors to establish a central selling organisation in each district is a step in the right direction, but in order to get full value from the scheme and eliminate competition between districts in the inland markets, some central co-ordinating authority is required.

In order to control the export market, the report visualises a "British Coal Export Association", the duties of which include the prevention

of price cutting and dealing with the more powerful Continental buyers.

The report should be studied by all interested in the future of the mining industry, summarising as it does the views of men in all walks of life. If viewed from the aspect of efficiency alone, its views are sound; but mining differs from any other industry in that its workers are often segregated in isolated communities, far from alternative forms of employment. Can we contemplate with equanimity the closing down of a number of mines, the sole source of livelihood of many village communities? The promptings of the heart must influence the dictates of the head, and consequently the provision of adequate alternative employment is essential before many of the recommendations in the report can come into effect.

J. A. S. RITSON.

### Illustrations of New Conifers

By H. Clinton-Baker and A. Bruce Jackson. Pp. ix + 78 + 96 plates. (Hertford: Simson and Co., Ltd., 1935.) 84*s*.

IN 1909 Mr. Clinton-Baker and Mr. A. Bruce Jackson were jointly responsible for the publication of two volumes of very good illustrations and descriptions of the older introduced conifers, and four years later they produced a third volume dealing with some of the lesser known species. The work was so well received, and has since proved so useful, that the authors were induced to undertake a fourth volume to include illustrations of the more recently introduced species and little known kinds that had previously been omitted. Unfortunately, Mr. Clinton-Baker did not live to see the new volume published, for he died in April, 1935, as the work was going through the press. Mr. Clinton-Baker inherited a pinetum that had been formed by his grandfather nearly one hundred years ago, and he planted a large number of additional species. In a memorial notice following the introduction to the new volume, Mr. Jackson pays tribute to his colleague's great love for plants and trees and to his ardour in maintaining the arboricultural traditions of Bayfordbury. The frontispiece to the new volume depicts some old cedars of Lebanon that are, apparently, the ones referred to in the first volume as having been planted to commemorate the building of the house at Bayfordbury in 1765.

The illustrations in the new volume are excellent in every way, and the descriptions are equally good. Species of Chinese *Abies* and *Picea* are well represented, but there are also species of numerous other genera including *Agathis*, *Araucaria*, *Widdringtonia*, *Callitris*, *Pinus*, *Podocarpus*, *Cupressus*, *Larix*, *Tsuga*, *Libocedrus* and *Cedrus*. Unfortunately, a plant has been wrongly figured as *Diselma Archeri*, but the authors are not altogether to blame for that. A small shoot bearing only the appressed scale-like type of leaves was sent to Kew for identification and the suggestion was made that it was the little-known Tasmanian plant, *Diselma Archeri*. However, that decision had to be altered some time later when specimens were seen showing both juvenile and mature types of leaves and fruits, which indicated that the plant in question was *Juniperus bermudiana*. Small shoots of *Diselma Archeri* and *Juniperus bermudiana*, bearing only the small appressed type of leaf, are very similar in appearance.

The four volumes of illustrations will be a lasting memorial to the authors, both of whom paid great attention to conifers over a long period.

### Dictionnaire de la Chemie et de ses Applications

Par Dr. Clément Duval, Dr. Raymonde Duval, Dr. Roger Dolique. (Science, Technique, Métiers: Bibliothèque de Formation professionnelle.) Pp. xxxii + 747. (Paris: Hermann et Cie, 1935.) 90 francs.

THIS dictionary is a glossary of French scientific and technical terms, and covers a wide field of pure and applied chemistry. Although it occupies but 747 pages of small format and the subject matter is necessarily greatly compressed, it is surprisingly complete. For example, it includes the trivial names and the composition of a very large number of pharmaceutical preparations.

The information appears to be up-to-date, but owing to extreme compression there are no references to the literature, and the reader is therefore left to his own devices if he wishes to check a given point or obtain further information.

Apart from its value as a glossary of purely technical terms, the book should be useful as a means of reference to those who have occasion to read articles of a technical nature but have no access to a reference library.

### Lehrbuch der Chemie

Von A. F. Holleman. Organischer Teil. Lehrbuch der organischen Chemie. Von A. F. Holleman. Zwanzigste, umgearbeitete und vermehrte Auflage von Friedrich Richter. Pp. xii + 546. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) 14 gold marks.

THE large number of editions of Holleman's book is a measure of its popularity, and this appears to be well deserved. The present edition has been thoroughly revised and brought up to date; it embodies brief accounts of such developments as the synthesis of the anthocyanins, the structure of the sterols and bile-acids, chlorophyll and the vitamins. The theoretical side of the science is perhaps somewhat neglected as compared with the purely structural: for example, only a very brief mention is made of the modern theories of benzene substitution, without reference to the workers in this field after Vorländer. Similarly, acetoacetic ester and the oximes are the only examples of tautomerism quoted, and the existence of other (and simpler) types is not referred to.

The book is well printed and produced, even though the binding leaves something to be desired.

**Visibility in Meteorology:**
the Theory and Practice of the Measurement of the Visual Range. By W. E. Knowles Middleton. Pp. viii+104. (Toronto: University of Toronto Press; London: Oxford University Press, 1935.) 8*s*. 6*d*. net.

"How far can I see to-day?" This question "assumes in the minds of the aviator and navigator an importance greater, perhaps, than that of any other meteorological matter. For such men it takes the place of that great public question which Sir Napier Shaw has called the fundamental problem of meteorology—'Will it rain to-morrow?'" Thus far the author who, in his introductory chapter, remarks very pertinently that the term *visibility* was not well chosen, the visibility of an object being an expression of the ease with which it can be seen, whereas "visibility" is a distance, and moreover, is the distance at which an object cannot be seen.

Methods for the estimation of visual range and a knowledge of the factors on which visual range depends are subjects of the first importance for those concerned with matters of transport, and the appearance of this monograph is very timely. Beginning with a general account of the behaviour of light in the atmosphere, the author proceeds to a discussion of the appearance of objects and of light sources seen through the lower atmosphere, linking up this discussion to calculations of the visual range by day of black, white, grey and coloured objects, the visual range of objects by moonlight and starlight, and the visual range of light-sources at night.

So far the exposition is general and theoretical, and the author now proceeds to a description of experimental work, of the estimation of visual range in practice, of the dependence of visual range on the other meteorological elements and of a rational scale of visual ranges.

The literature of the subject is already wide (the author provides a bibliography of about a hundred and fifty items) and scattered, and the author has done a real service in bringing together this literature and analysing it critically in a manner clear, stimulating and concise. A. F.

**Anatomy of the Rat**
By Eunice Chace Greene. (Transactions of the American Philosophical Society, New Series, Vol. 27.) Pp. xi+370. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1935.) 22*s*. 6*d*. net.

THIS book on the topographical anatomy of the rat is more detailed than that on any other laboratory or domestic animal. In addition to such systems as are usually treated at length in a dissecting manual, special attention has been devoted to the circulatory, nervous and endocrine systems. Thus there is a wealth of information for the biochemist and pathologist, no less than the anatomist, inasmuch as the Wistar rat has not only become the most common experimental animal, but has also attained the position of the animal presenting the highest standard of accuracy in anatomical description.

**Fundamentals of Biochemistry:**
in relation to Human Physiology. By T. R. Parsons. Fifth edition. Pp. xii+453. (Cambridge: W. Heffer and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

MR. PARSONS' original aim was to produce a theoretical treatise on biochemistry containing much less information than is given in the larger treatises but enough to describe in a continuous story the principles of an involved and growing subject. The book is now in its fifth edition, showing that it has met a demand, and it remains chiefly to note that the fruitful progress which is being made has enabled new sections to be recorded dealing with subjects which had long been thought to be of the greatest complexity. These relate to the chemistry of muscle metabolism, of the sex hormones and of the flavines. The speed at which new discoveries are being made in these and other fields of inquiry which are fashionable for the moment is quite remarkable; it contrasts with the lack of progress in certain other sections—at least this is the impression which the reviewer has gained from his perusal of the book.

**The Philosophy of a Biologist**
By Prof. J. S. Haldane. Pp. xii+155. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 6*s*. net.

THIS little monograph may be considered almost as the philosophical testament of a distinguished biologist. In it he gives his ultimate conclusions based on a lifetime of eminent achievements in the biological field. After a searching, but sympathetic, criticism of some conclusions based on physics, biology and psychology, Prof. Haldane asserts that the real universe is a universe of personality and the manifestation of God; and that its scientific aspects are only partial interpretations of it, its imperfect nature being revealed by philosophical criticism. No doubt materialists and mechanicists would take exception to some of the arguments or appreciations put forward by the author; but they would recognise no less readily the sincerity of purpose and generous ideals of a great mind who is now mourned by his intellectual peers throughout the world. T. G.

**Handbook of Botanical Diagrams**
By Dr. Blodwen Lloyd. Pp. 112. (London: University of London Press, Ltd., 1935.) 8*s*. 6*d*.

DR. LLOYD'S book contains a collection of good and well-reproduced diagrams to illustrate the usual first-year university course in botany. It therefore covers the syllabuses for Intermediate Science, First Year Medical, and Higher School Certificate examinations.

Although the whole work is well produced and attractive, it is very difficult to realise its usefulness. Not one of the diagrams would be found lacking in a text-book of this standard, though, of course, these illustrations are naturally reproduced on a larger scale. It is difficult to prevent students copying text-book diagrams; but it is a pity to encourage it, as this book certainly does. In any event, it can serve only as a supplement to a text-book, and as such, the price is rather high.

# Role of Chemistry in the Study of Atomic Transmutation

By Prof. F. A. Paneth

"THE history of Alchemy is the history of an error." Such was, about seventy years ago, Hermann Kopp's short summary of centuries of attempts to transmute chemical elements[1]. It is well known that two generations later alchemy became a reality, when it had passed from the realm of the chemists to that of the physicists, who not only possessed the right weapons for attacking the atoms but also invented methods of detecting transmutations of matter on an infinitely smaller scale than those sought by chemists. One must, however, not overlook the importance of the help which was, and is, given by chemistry in many cases where a process of transmutation has to be investigated.

A combination of physical and chemical methods, frequently manifested by the collaboration of a physicist and chemist, was a decisive factor in the early days of radioactivity. The discovery, in 1898, of the new elements polonium and radium was due to the first application, by Pierre and Marie Curie, of the methods of 'radiochemistry'; that is, the ordinary methods of analytical chemistry were employed with invisible substances, and the effect of the attempted separations controlled by electrometric apparatus for the measurement of radioactive rays. Soon afterwards the 'active deposits', first considered as a sort of 'induced activity', were recognised as chemical substances with a definite behaviour through their response to treatment with acids, co-precipitation with various metals, etc. Further, the theoretical foundation of the whole science of radioactivity, the disintegration theory of Rutherford and Soddy, could only be laid after uranium and uranium X, thorium and the rare gas thorium emanation—to quote only two of the historically most important cases—had been chemically separated and their isolated radiations investigated.

After a few years of such radio-chemical studies, chemistry, making use only of its familiar methods, was able to confirm the fact of radioactive transmutation. A natural consequence of Rutherford's recognition of the $\alpha$-rays as charged helium atoms was the expectation that any radio-element which emitted $\alpha$-rays would evolve in the course of time a definite amount of helium gas. When in 1903 Ramsay and Soddy[2] succeeded in separating, purifying and identifying spectroscopically the helium newly formed in a radium salt, this first chemical demonstration of the fact that a well-known element had obviously sprung from another well-defined chemical element appealed especially to all those not acquainted with the radio-chemical technique of identifying invisible substances; although, therefore, the result of this experiment had been predicted, its influence on the definite acceptance of the idea of elementary transformation was very marked. It was comparatively easy later to show in a similar fashion the evolution of radium emanation from a radium solution, and to measure its quantity[3] and photograph its spectrum[4]; but besides helium and radon there is only one more element which, as a product of radioactive disintegration in the laboratory, has ever been chemically identified: radium D, originating from radon, has been collected by electrolytic deposition on a platinum anode, where it displays the characteristic colour and electrochemical potential of the isotopic lead superoxide[5].

Neither radio-chemical nor chemical methods played any part in the discovery and early development of the artificial transmutation of elements brought about by bombardment with $\alpha$-rays. The fluorescent screen, used by Rutherford and Chadwick in their pioneer work in 1919, as well as the Wilson chamber and electrometric devices which were applied later, were able to record one single atomic disruption; and so much information could be collected by the careful interpretation of the observed phenomena that in many cases it was possible to write the full equation of the transmutation, including the chemical character of the new products, without a single chemical experiment having been performed. In this way even new atomic species of known elements have been discovered, and atomic weights have been determined with an accuracy superior to all other figures previously obtained[6]. Nevertheless, if chemical, or at least radio-chemical, methods could have been applied, they would not only have offered a means of checking indirect conclusions but also in many cases even decided between different possibilities. Radio-chemical methods were, naturally, excluded so long as only stable atoms were found as the products of artificial disintegration; but chemical detection of, for example, hydrogen produced by the $\alpha$-ray bombardment of nitrogen, did not seem to be entirely out of the question, since the sensitivity of the spectroscopic identification of hydrogen in helium, according to a

statement of Collie and Ramsay[7], should be just high enough. A recent investigation[8], however, showed the experimental basis of this claim to be wrong.

The whole situation has now changed since the discovery of artificial radio-elements and the appearance of neutrons and of helium atoms among the products of artificial disintegration. When, two years ago, Irene Curie and F. Joliot[9] observed that in some cases the results of artificial transmutation were not stable but that they decayed with the emission of radiation much in the same way as the natural radio-elements, all the methods developed for the study of the latter became immediately applicable. While the instantaneous process of collision can only be investigated by the apparatus mentioned above, the subsequent radioactive disintegration opens the field for characterisation of the new products by their periods of decay, the quality of their rays, and—last but not least—their radio-chemical behaviour. Curie and Joliot[10] showed, for example, that a minute percentage of boron atoms bombarded by $\alpha$-rays are transformed into a substance which emits positrons, decays with a half-value period of 14 minutes, and shows the chemical reactions expected of nitrogen; on the other hand, the chemistry of a product generated in the same way from aluminium accorded with the supposition of its being phosphorus. Here, for the first time in processes of artificial transmutation, it was proved chemically that new elements had been formed, and from the positions of these elements, as compared with the old ones, the mechanism of the nuclear changes could be deduced, independently of the conclusions reached by physical observations.

This fruitful collaboration of the chemist with the physicist was continued on a much larger scale by Fermi and his co-workers[11], who showed that bombardment by neutrons was effective in creating artificial radio-elements throughout the periodic system, up to the highest elements. The impact of a neutron on the nucleus of an atom may result in its capture, with or without simultaneous ejection of an $\alpha$-particle or a proton. In the case of aluminium it was found that all three reactions occur:

$$ {}^{27}_{13}\mathrm{Al} + {}^{1}_{0}n \rightarrow {}^{4}_{2}\mathrm{He} + {}^{24}_{11}\mathrm{Na} \quad (T = 15{\cdot}5 \text{ hr.}) $$

$$ {}^{27}_{13}\mathrm{Al} + {}^{1}_{0}n \rightarrow {}^{1}_{1}\mathrm{H} + {}^{27}_{12}\mathrm{Mg} \quad (T = 10 \text{ min.}) $$

$$ {}^{27}_{13}\mathrm{Al} + {}^{1}_{0}n \rightarrow {}^{28}_{13}\mathrm{Al} \quad (T = 2{\cdot}3 \text{ min.}) $$

In order to demonstrate the isotopy of the three new radio-elements with sodium, magnesium and aluminium respectively, the same method could be applied which, especially in the hands of Soddy and Fleck[12], had proved so useful in establishing the chemical character of the shorter-lived natural radio-elements; small amounts of the supposed ordinary isotopes were added and, after thorough mixing, it was shown by analytical chemical operations that the activity of 15·5 hours half-period was inseparable from the sodium, that of 10 min. half-period was inseparable from the magnesium, and that of 2·3 min. half-period inseparable from the original element aluminium.

In cases like the last where isotopy with the bombarded element has to be tested, it is especially necessary first to ensure the completeness of the mixing, because it is well known that differences in the chemical or colloidal state between the radio-element and its isotope, which have been present from the beginning, may give a false impression of a chemical separability[13]. Now, as a consequence of the formation of the artificial radio-element by the capture of a neutron, the chemical linkage of its parent element has necessarily been broken, and the new radioactive atom may be in quite a different chemical or physical state; the fact that for this reason the new isotope can often be easily severed from the parent element, although not a 'separation of isotopes' in the technical sense, provides a valuable method for its concentration, as was first pointed out by Szilard and Chalmers[14].

Other similar instances in which the study of the chemical nature of artificial disintegration products has been useful in clearing up the mechanism of the nuclear change are already much too numerous to be mentioned here. Naturally the more complicated the transformation process, so much the more welcome becomes the help of the chemist. Bombardment of thorium seems to lead to the building up of a series of subsequent radio-elements, in its general behaviour similar to, but differing from, the three known disintegration series; chemical investigation has assisted in disentangling the mixture of the new active atoms[15]. It has been reported[16], too, that the active isotope of chlorine ${}^{38}_{17}\mathrm{Cl}$, resulting from bombardment of ordinary chlorine with slow neutrons, does not immediately change into a stable substance, but that first an isotope of argon ${}^{38}_{18}\mathrm{A}$ is formed, which, with emission of $\alpha$-rays, is converted into a sulphur isotope ${}^{34}_{16}\mathrm{S}$; the inertness of the noble gas argon should make it a simple affair for the chemist to test this assumption of an active argon isotope.

A much more difficult but very interesting task was set to chemistry after it had been found by Fermi and his collaborators that neutron bombardment of uranium produced a '13-minute-body' and a '90-minute-body', the position of which in

the system of elements could be either below or above uranium, highest of the known elements, since the mechanism of their formation remained obscure. Peculiar features in the analytical chemical behaviour made Fermi[17] believe that unknown elements above uranium had been formed. This was challenged by v. Grosse[18], who stated that the reactions of both bodies were identical with those of element 91, protactinium; but the discoverers of protactinium, Hahn and Meitner[19], by mixing the new radio-elements with the protactinium isotope uranium Z, showed them to be separable from protactinium, thus disproving Grosse's statement and supporting Fermi's claim of having discovered elements with atomic numbers higher than 92. From a study of these two bodies, which would appear to be subsequent members of a radioactive series, and perhaps themselves complex, chemistry, in its turn, will gain information about a previously inaccessible region of the periodic system.

We have mentioned above that in the development of the science of natural radioactivity, first radio-chemical, and then purely chemical, methods could be used for the identification of the products of transmutation. To-day, in the study of artificial transmutations, the second stage has been likewise reached. It is obvious that the task is here more difficult, owing to the much lower yield of newly formed matter. If we have at our disposal a quantity of 100 m.c. radon, by its complete decay $2 \times 10^{-4}$ c.c. helium is formed; if, however, we use the same quantity of radon for the classical artificial disintegration of nitrogen, the amount of hydrogen produced is only of the order of $10^{-9}$ c.c., as only about one in a hundred thousand $\alpha$-particles liberates a proton from a nitrogen nucleus; which, together with special difficulties met with in the microchemistry of hydrogen, explains the failure of the attempt mentioned above to identify by chemical means the artificially produced hydrogen. Recently, however, more effective processes of artificial transmutation have been discovered; by their impact on beryllium, one in about ten thousand $\alpha$-particles knocks out a neutron from a beryllium nucleus[20] according to the equation:

$$^{9}_{4}\mathrm{Be} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{1}_{0}n + {}^{12}_{6}\mathrm{C}.$$

The neutrons are beyond chemical detection, nor is it possible to find such small traces of carbon in beryllium; but, after being slowed down by collision with hydrogen nuclei, the neutrons can be used up almost quantitatively by the reaction[21]:

$$^{10}_{5}\mathrm{B} + {}^{1}_{0}n \rightarrow {}^{4}_{2}\mathrm{He} + {}^{7}_{3}\mathrm{Li},$$

thus producing an approximately equal number of helium atoms; and the microchemical detection and measurement of small quantities of helium is astonishingly safe. In an experiment, based on these considerations, the neutrons, produced by the decay of about 2,000 mc. of radon mixed with beryllium, were used for the bombardment of one litre of boron methylate; less than $10^{-10}$ gm. of boron was disintegrated according to the above equation, and the corresponding $10^{-7}$ c.c. of helium separated from the ester, identified spectroscopically, and measured by a special manometer[22].

This fact that the artificial generation of an element has now been chemically proved by its preparation in bulk, without making use for its identification of any sort of radioactive method, such as fluorescent screen, Wilson chamber or electrometer, is a step nearer to the old alchemistic goal, although the amount of newly formed matter is still so small that only delicate microchemical methods can deal with it. As in Ramsay and Soddy's experiment, in which the production of helium by radioactive decay was shown for the first time, the qualitative result could be predicted; but in both cases the way to exact quantitative measurements has thereby been opened. It may well be that there are processes of transmutation going on with so little energy that the radio-physical and radio-chemical methods of detection cannot be applied; there is now hope that in some such cases ordinary chemistry will be able to discover the newly formed elements.


[1] H. Kopp, "Beiträge zur Geschichte der Chemie", I (Braunschweig, 1869), p. 17.

[2] W. Ramsay and F. Soddy, NATURE, 68, 246 (1903). *Proc. Roy. Soc.*, *A*, 72, 204 (1903).

[3] W. Ramsay and F. Soddy, *Proc. Roy. Soc.*, *A*, 73, 346 (1904).

[4] E. Rutherford and T. Royds, *Phil. Mag.*, 16, 313 (1908).

[5] G. v. Hevesy and F. A. Paneth, *Ber. deutsch. chem. Ges.*, 47, 2784 (1914).

[6] H. Bethe, *Phys. Rev.*, 47, 633, 795 (1935). M. L. E. Oliphant, A. R. Kempton and Lord Rutherford, *Proc. Roy. Soc.*, *A*, 150, 241 (1935).

[7] J. N. Collie and W. Ramsay, *Proc. Roy. Soc.*, *A*, 59, 257 (1896).

[8] F. A. Paneth and P. L. Günther, NATURE, 131, 652 (1933); *Z. phys. Chem.*, *A*, 173, 401 (1935).

[9] I. Curie and F. Joliot, *C.R.*, 198, 254 (1934).

[10] I. Curie and F. Joliot, *C.R.*, 198, 559 (1934).

[11] E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, *A*, 146, 483 (1934); E. Amaldi, O. D'Agostino, E. Fermi, B. Pontecorvo, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, *A*, 149, 522 (1935). O. D'Agostino, *Gizz. chem. ital.*, 64, 835 (1934).

[12] A. Flock, *Trans. Chem. Soc.*, 103, 381, 1052 (1913).

[13] See, for example, "Handbuch Phys.", 22 (1) (Springer, Berlin, 1933), 445.

[14] L. Szilard and T. A. Chalmers, NATURE, 134, 462 (1934). F. A. Paneth and J. W. J. Fay, NATURE, 135, 820 (1935).

[15] I. Curie, H. v. Halban and P. Preiswerk, *C.R.*, 200, 1841 and 2079 (1935). O. Hahn and L. Meitner, *Naturwiss.*, 23, 320 (1935).

[16] W. F. Libby, M. D. Peterson, W. M. Latimer, *Phys. Rev.*, 48, 571 (1935).

[17] E. Fermi, NATURE, 133, 898 (1934).

[18] A. v. Grosse and M. S. Agruss, *Phys. Rev.*, 46, 241 (1934); NATURE, 134, 773 (1934); *J. Amer. Chem. Soc.*, 57, 438 (1935).

[19] O. Hahn and L. Meitner, *Naturwiss.*, 23, 37, 230 (1935).

[20] R. Jaeckel, *Z. Phys.*, 91, 493 (1934).

[21] J. Chadwick and M. Goldhaber, NATURE, 135, 65 (1935); *Proc. Cam. Phil. Soc.*, 31, 612 (1935). H. J. Taylor and M. Goldhaber, NATURE, 135, 341 (1935). E. Fermi and co-workers, *Proc. Roy. Soc.*, *A*, 149, 522 (1935).

[22] F. A. Paneth and H. Loleit, NATURE, 136, 950 (1935).

mainly in the *Journal of Physiology*, of an important series of papers on the blood and respiration, which not only did much to establish his own fame, but also made world-wide the reputation of the Oxford Schools of Physiology and Medicine and led to general recognition of the importance of the study of human physiology. The earliest of these papers was a short note in which he disproved D'Arsonval's idea that some poisonous impurity was given off in expired air. This note contains his first suggestion that carbon dioxide is the most important factor in regulating the respiration, and was amplified in 1893 in two papers in the *Journal of Pathology and Bacteriology*. Two papers on respiratory exchange followed, and then in 1894 Haldane and Lorrain Smith visited Christian Bohr's laboratory at Copenhagen, where they worked on the specific oxygen capacity of the blood, and learned much about gas analysis.

Haldane was remarkable for his skill in devising methods of investigation no less than for the broad view he took of physiological problems, and from the knowledge he acquired from Bohr he developed his technique of gas analysis, which has been generally adopted. He published his first description of his apparatus for air analysis in the *Journal of Physiology* in 1898, and afterwards gave a further account of his methods in "Methods of Air Analysis", 1912. This book obtained wide recognition, and in the preparation of subsequent editions Haldane was helped by his colleague, Dr. Ivon Graham. As was written of another—"The very air we breathe, he has taught us to analyze, to examine, to improve".

In 1895 Haldane began an inquiry into the nature and action of the suffocative gases met with in the air of coal mines, and was thus led to investigate the physiological action of carbon monoxide, the poisonous effect of which he showed to be due solely to its power of combining with hæmoglobin and so putting it out of action as an oxygen carrier. It was with astonishing insight that Haldane saw how this work opened the way to an effective attack on many important problems. He devised a simple method of detecting and estimating carbon monoxide in air by carmine titration of blood with which the air was shaken; he found that the stability of the carbon monoxide–hæmoglobin complex in the presence of oxygen was much decreased by the action of light; he devised a method of deducing the oxygen tension of human arterial blood from its saturation with carbon monoxide after breathing air containing this gas; he investigated the evidence that carbon monoxide is oxidised in the body and found it unsatisfactory; he determined the mass and oxygen capacity of the blood in man by the carbon monoxide method and he devised his modification of Gowers' hæmoglobinometer, which is still unequalled.

During these years Haldane did other important work on the blood pigment and its derivatives. He investigated the action of ferricyanide on the oxygen—and carbon monoxide—hæmoglobin complexes and showed that this reaction could be used to determine accurately, without the use of the blood-pump, the volume of oxygen capable of being absorbed by hæmoglobin. On this basis in 1902 he designed, with Barcroft, an apparatus for accurately measuring the oxygen and carbonic acid in small quantities of blood. Later this apparatus was improved by Brodie, and Barcroft developed from it his well-known 'differential' apparatus. In 1920 Haldane improved the method by substituting measurement of the gas liberated at constant pressure instead of at constant volume.

In 1903 Haldane turned again to the important, but then obscure, problem of the regulation of the respiration, the key to the solution of which he had already indicated in 1893. With the help of his own methods of gas analysis and by the simplest means, he proved that it was possible to obtain and analyse samples of 'alveolar air', and he made many observations on the composition of this alveolar air in human subjects at rest and during muscular work, as well as when they were exposed to widely differing barometric pressures or were breathing air containing excess or deficiency of oxygen or carbon dioxide. He was thus able to show the exquisite sensitiveness of the respiratory centre to changes in arterial carbon dioxide pressure, and to afford an insight into the means by which the breathing is so regulated as to satisfy the varying requirements of the body from moment to moment. It is on this fundamental basis that the whole of our knowledge of the physiological regulation of the breathing is securely founded.

This work, which was published in 1905, was undoubtedly the most important of Haldane's physiological researches, and the results formed perhaps the strongest foundations on which he based his philosophy of biology. Apart from revolutionising the ideas then prevalent about the regulation of the breathing, it indicated far more clearly than had been done before the amazing delicacy with which different physiological functions are co-ordinated, and it made intelligible the responses of the body to differing conditions. Later he extended the results of this paper, and then turned to the investigation of the effects of low atmospheric pressure and want of oxygen on the respiration, and showed the explanation of periodic breathing.

In 1911 Haldane led an expedition to Pike's Peak to study the effects of low atmospheric pressures and the process of acclimatisation, and afterwards published further work on this subject. In his last years he was keenly interested in the physiological problems of very high flights.

In 1913 and 1914 Haldane investigated the absorption and dissociation of carbon dioxide by human blood and devised a method of determining the circulation rate in man which was founded on the results so obtained. In 1916 he took up the question of the nervous regulation of the respiration and showed how this was related to the chemical regulation. His later work on respiration was concerned with the respiratory response to anoxæmia and the effects of shallow breathing and resistance to the respiration.

His measurements by his carbon monoxide method of the oxygen pressure of arterial blood together with many other observations had convinced him that in

certain circumstances secretion of oxygen inwards must occur in the lungs. Krogh's aerotonometer measurements, however, indicated equally clearly that diffusion alone sufficed to account for the facts. Both methods seemed to be reliable and the discrepancy between the results they gave remained unexplained until Haldane proved from his observations on shallow breathing that they did not measure the same thing. The aerotonometer method measures the oxygen pressure of the mixed arterial blood leaving the lungs, while the carbon monoxide method measures the average of the oxygen pressures of the blood in different parts of the lungs, some of which are well, but others poorly, ventilated.

Haldane maintained that oxygen secretion by the lungs is one of the most important factors in acclimatisation to high altitudes, and that it may be aroused in other circumstances when the body is subject to deficiency of oxygen; he also believed that it may come into play during muscular work.

Haldane's physiological work was by no means confined to respiration. He studied the responses of the body to high external temperatures, and found that activity of the sweat glands evokes adjustment of other physiological functions in a particularly interesting manner. He also showed that the activities of the kidneys are closely connected with those of other organs and that their response to chemical stimuli is of the same order of delicacy as that of the respiratory centre. From his observations of coloured shadows and contrast he found further support for his interpretation of physiological phenomena.

Work with Haldane was at once an education and a delight. His wide views based on his philosophy enabled him to see essentials and disregard non-essentials so surely that the true value of his clear and simple conclusions could perhaps be fully appreciated only by those who had the privilege of working with him. Of practical experimental procedure, too, he was a master. His results could scarcely be surpassed in accuracy, though his methods were his own. His adherence, for example, to the use of a wooden match as an aid in reading a burette remained unshaken by the introduction of electric torches. He was not upset by conditions which would fill many with dismay. His analyses were just as efficiently conducted at the bottom of Dolcoath mine or in the middle of the night in the Station Hotel at Inverness as in his laboratory at Oxford. Those who worked with him had to conform to his customs. Work generally did not begin before midday, despite any arrangements which might have been made previously for a special occasion. Once begun, it was apt to continue until 2 or 3 a.m., though tea and dinner were not lightly disregarded. Though these ways were occasionally a little trying to those adapted to a different routine, they only increased an affection which was founded on admiration of his genius and his never-failing kindness, and appreciation of his humour. Though he was an acute critic, there is no record among those who worked with him of Haldane's ever being out of temper, and the bond between them is one of the most remarkable tributes to his character.

Great as Haldane was as a physiologist, he was equally great—indeed unique—as an investigator of the physiological problems of industrial hygiene. In 1896 he made a report on his investigations of the cause of death in three colliery explosions. He had already shown that the then prevalent view as to the symptoms produced by exposure to black damp and after-damp was inaccurate, and his report forms the basis of the measures which have been devised and are in force throughout the world for dealing with the dangers due to fires and explosions underground. From that time Haldane's interest in problems affecting the health of miners never slackened, and he was untiring in his investigation of such matters as the ventilation of mines and the prevention of underground explosions, ankylostomiasis among Cornish miners, the effects on underground workers of inadequate illumination and of high atmospheric temperatures, and liability to silicosis in consequence of the inhalation of different kinds of dust. His never-failing devotion to the welfare of the miners, and the value of his work, were recognised in 1912 by his appointment as Director of the Doncaster Coal Owners' Research Laboratory, and brought him the unique honour for a physiologist of being elected to the presidency of the Institution of Mining Engineers in 1924.

As one of the Gas Referees under the Board of Trade, Haldane did invaluable work on the composition and properties of illuminating gas.

The Home Office, the Army and the Navy, too, owed much to Haldane. He served on many commissions and was a member of a committee which inquired into the physiology of the soldiers' food, clothing and training, and the report of which brought about important reforms. During the Great War, he was called upon to advise about protection against poison gases, and not only did valuable work with regard to emergency provision of respirators but also pointed out that only some form of box respirator could ensure protection. He did valuable work on the pathology and treatment of gas poisoning and made clear the physiological effects of shallow breathing, which was a prominent symptom in chronic cases. Recognising the grave dangers of anoxæmia, he devised an apparatus for the economical and effective administration of oxygen.

For the Navy, Haldane investigated the ventilation of battleships and submarines, but his most important work was his inquiry into the difficulties and dangers besetting divers. His characteristic insight enabled him to grasp at once the cause of the serious limitation of the divers' capacity to do muscular work, of which complaint was made. He showed that this was due to the high pressure of carbon dioxide present in their helmets owing to the inadequacy of the pumps then in use. Having made sure that the divers' air supply was sufficient, he began a thorough investigation of compressed air illness and its prevention, and set to work to devise a method of decompression both safe and time-saving. He noticed that symptoms in animals and men only occurred after rapid decompression from a pressure at least one atmosphere in excess of normal to sea-level pressure, and proved

by an extensive experimental investigation that the method of very slow decompression was in some respects actually harmful. He also proved that a method of 'stage decompression' was both safer and quicker. He calculated tables for regulating the safe rate of decompression of divers by stages corresponding to the pressures to which they had been exposed and the duration of their exposure. He again took up this problem in 1935 and worked out tables for still greater pressures. His stage decompression is now generally used and has undoubtedly saved many lives, besides making it possible for divers and tunnellers to work at pressures otherwise unattainable.

Haldane gave a full account of his work on the physiology of respiration and of some of his investigations in applied physiology in his Silliman Lectures, which were published under the title "Respiration" in 1922. A new edition, to the rewriting of which he devoted much time and care, appeared in 1935. In this book, unrivalled since it first appeared, he has left a record worthy of his genius.

Haldane was created a Companion of Honour in 1928 in recognition of his scientific work on industrial hygiene. The many other honours which he received, and which are recorded elsewhere, included the Copley Medal of the Royal Society in 1934.

Only a few weeks before his death, which occurred after a short illness on March 14, in his seventy-sixth year, Haldane had returned, apparently in good health, from a visit to Persia and Iraq, whither he had gone to study heat-stroke.

Haldane's influence on all aspects of physiological thought has been enormous and his loss is not only a bitter blow to those who knew and loved him, but also leaves a gap in the application of physiology to industrial and medical problems which will indeed be hard to fill.

J. G. P.

## Mr. Maurice C. Macmillan

A MONTH ago we recorded with much regret the death of Mr. George A. Macmillan, one of the directors of Messrs. Macmillan and Co., Ltd., the publishers of NATURE. Another link connecting the journal with this publishing firm has now been broken by the death on Monday last, March 30, at eighty-two years of age, of Mr. Maurice Crawford Macmillan, brother of Sir Frederick Macmillan, the chairman of the company, and cousin of Mr. George Macmillan.

The firm was founded in 1843, when Mr. Daniel Macmillan, the father of Sir Frederick and Mr. Maurice Macmillan, was joined by his younger brother Alexander and published the first volume with the name of Macmillan on the title-page, namely, A. R. Craig's "Philosophy of Training". Seven years later the firm adopted the title Macmillan and Co., which it has retained ever since.

Mr. Maurice Macmillan entered the business in 1882, after a distinguished career at Uppingham and Cambridge, followed by five years' experience as an assistant master at St. Paul's School, under Dr. Walker. He devoted himself particularly to the educational side of the business, and to him is largely due the comprehensive list of standard books for students of all standards and subjects published by the firm. He was keenly interested in every aspect of educational work, from the primary school to the university, and he followed with close attention all developments in methods of teaching scientific and other subjects. He was chiefly responsible for the establishment of branches of the firm in India, Australia and other centres where the educational publications of the firm are largely used.

Though NATURE was founded several years before Mr. Maurice Macmillan came into the firm, he was always an encouraging supporter of it and was keenly interested in many scientific subjects dealt with in these columns. In this, as well as in the selection of books of high standard, he rendered valuable service to science, and we pay a grateful tribute to him for his great work and beneficial influence over a period of many years. He leaves three sons, two of whom, Mr. Daniel Macmillan and Mr. Harold Macmillan, M.P., are directors of the firm.

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MR. GEORGE HUBBARD, a London architect of distinction, who was twice a vice-president of the Royal Institute of British Architects, died at his residence at Eltham on March 19, his seventy-seventh birthday. Mr. Hubbard was well known as an archæologist and collector of antiquities. His most noteworthy contributions to archæological studies were a paper on "Architecture on the Eastern Side of the Adriatic", and in prehistoric archæology a book written in conjunction with his brother, A. J. Hubbard, on "Neolithic Dew Ponds and Cattleways", published in 1905, which went far to settle finally the problem of the construction and uses of this primitive method of dealing with deficiencies of water supply.

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WE regret to announce the death at the age of sixty-nine years on February 27 of Prof. Charles Jules Henri Nicolle, for more than thirty years director of the Pasteur Institute of Tunis, and professor at the Collège de France. He is best known for his work on typhus, which in 1909 he proved to be transmitted by the clothes louse. He was also a pioneer in the prophylaxis of this disease and of measles, in addition to much valuable work on other infectious diseases, for which he was awarded the Osiris Prize of the Institut de France in 1927, and a Nobel Prize in 1928. Prof. Nicolle was a member of the Paris Academies of Sciences and Medicine, and an honorary fellow of the Royal Society of Medicine.

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WE regret to announce the following deaths:

Sir Archibald Garrod, K.C.M.G., F.R.S., formerly regius professor of medicine in the University of Oxford and consulting physician to St. Bartholomew's Hospital, on March 28, aged seventy-eight years.

Sir Joseph Petavel, K.B.E., F.R.S., director of the National Physical Laboratory, Teddington, on March 31, aged sixty-two years.

# News and Views

### Ancient Monuments in Northern England

In view of the services which are being rendered to archæological and historical studies by the Office of Works through its activities in protecting and preserving our ancient monuments, it is both an advantage and a necessity that the co-operation of the public should be obtained in furthering the purpose of this work. For this, among other reasons, it is desirable that a knowledge of aims and methods, as well as of what has already been achieved under existing legislation, should be as widely diffused as possible. Much depends here, as with the collections in our national museums, upon the extent to which a suitable literature is available, from which the visiting public may learn what is most significant and best worth attention. Already at many of the ancient monuments—ultimately, no doubt, at all of any importance—detailed accounts, which cover technical matters, as well as plans and general descriptive notes, are available for the visitor; but a broader view which entails comparative treatment has been attempted in a new series of official publications which has been inaugurated by the First Commissioner of Works himself ("Illustrated Regional Guides to Ancient Monuments under the Ownership or Guardianship of His Majesty's Office of Works: Vol. 1, Northern England". By the Right Hon. W. Ormsby-Gore. Pp. 52. London: H.M. Stationery Office. 1*s*.). It is interesting to note how Mr. Ormsby-Gore has attacked what is really a difficult problem. The average visitor may be expected to have a historical background adequate for appreciation of the character of Norman castle or abbey; but how will such a visitor approach, for example, the Devil's Arrows at Boroughbridge? Wisely, differential treatment has been adopted. In the historic period the monuments are classified, each according to its kind, and then briefly described *seriatim*, but for the prehistoric period, the prehistory of the region has been reviewed as a whole, the protected monuments being used to support and illustrate the argument. This has the additional advantage that it brings out the essential function of the Department far more clearly than would be possible in a mere annotated list.

### Electioneering in Ceylon

The results, and still more the methods of electioneering, in the recent general election for seats on the State Council of Ceylon, afford an instructive, if somewhat alarming, example of the effects of the break in tradition, which comes with the wholesale application of the machinery of Western democracy to an Eastern society, in which the exercise of individual judgment has had neither training nor opportunity to function independently of the social or religious communal group. Everywhere religion and caste dictated the decision of the electors. Group clashes were frequent, and twelve persons lost their lives. In at least two instances, it is stated by the Colombo correspondent of *The Times* in the issue of March 24, Christian members of long standing and conspicuous public service lost their seats to opponents, unknown before the contest, whose principal qualification appears to have been that they were Buddhists. This exploitation of sectional prejudice was, perhaps, no more than might have been anticipated, even though it scarcely appeared in the elections of four years ago. The grant of adult franchise to both sexes has placed on the electoral register 2,500,000 voters, of whom, it is estimated, 2,000,000 are illiterate. In consequence, the voting had to be conducted by the allocation of a colour to each candidate, the ballot paper being deposited in the appropriately coloured box in blank. Yellow, the Buddhist colour, swept the board. Of forty-three contested seats, thirty-three went to Buddhists, an increase from twenty-eight in the previous Council. Universal suffrage was granted to Ceylon on the report of the Donoughmore Commission, which visited the island in 1927; but the results of the present election have raised in an acute form the question whether it is likely to prove as beneficial as was anticipated. A strong body of influential opinion is pressing for an inquiry.

### The Race Problem

In his Friday Evening Discourse at the Royal Institution on March 27, Prof. Julian Huxley discussed "The Race Problem". It is obvious that different geographical groups of the human species differ inherently from each other; the term *race* is commonly employed to denote such a distinguishable group. Various difficulties crop up, however, as regards its usage in practice. First, characteristics which have no genetic basis, but are national, cultural, linguistic, etc., have been erroneously ascribed to races. For example, there cannot exist such a thing as an 'Aryan race', since the term Aryan concerns language; again, the main obvious differences between, say, the English, the French and the Germans, are not genetic but of national and cultural origin. Secondly, modern genetics has shown that after a cross, all possible combinations of the genes concerned will be produced, and will then continue to recur. In the absence of selection, no even approximately uniform blend will be formed. Thirdly, man is such a mobile organism that migration and intercrossing between different groups has been occurring on a large scale since before the dawn of history. Accordingly, nothing approximating to a pure race now exists, with the possible exception of a few remote and primitive tribes. *Race* is normally used of man in the same sense as race or subspecies of animals—that is, with an evolutionary implication.

At best, it may be legitimately used of the hypothetical major groups (for example, black, white and yellow) into which we deduce that our species early became differentiated, and which may be called *primary races*; and of the equally hypothetical subgroups apparently produced by later differentiation (for example, Nordic, Alpine or Mediterranean), which may be called *secondary races*.

AT the present day, there exists no important human group which can properly be called a race, and the use of the term not only has no useful application, but actually leads to confusion, both scientific and political. For groups of people genetically distinguishable from other groups, some non-committal term like *ethnic group* or *ethnos* is indicated. Ethnic groups of various degrees of difference will be distinguished; the only scientific method of so doing is to take the mean, the frequency curves, and the conditions of several measurable physical characters. For the common adjectival use of *racial* as opposed to national, cultural, etc., the terms *ethnic* or *genetic* should be used, according to circumstances. To define *race* in man scientifically is impossible, since the implications of the term do not conform with reality. Meanwhile, since the word race has been widely used in a pseudo-scientific way to justify and rationalise various political and nationalist activities, it is highly desirable that an international inquiry should be made which would result in an impartial scientific pronouncement on the subject.

### Defence Against Air Raids

IT is announced that the committee set up in February 1935, under the chairmanship of Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology, has been considering proposals from various sources for countering raids by enemy aircraft. The vast bulk of these suggestions are impracticable simply because of a lack of appreciation of the conditions. A certain number are workable up to a point, but depend upon the enemy being visible from the ground, or upon the defending aircraft being able to make contact with the attackers. Two factors in modern aeronautical development tend to militate these chances. Advances in navigation and blind flying enable raiders to remain continuously in clouds, with a reasonable chance of reaching their objective. If observed, owing to an unexpected breaking of the cloud curtain, the high speed of modern aircraft helps them to avoid any measures directed against them from the ground, and also to keep away from defending aircraft, unless the latter are already at the same height and of considerably greater speed. There are, however, schemes in hand which promise workable results. Wireless-controlled aircraft either carrying explosives or depending upon direct collision, aerial bombs moored by balloons or carried by parachutes forming a screen, mechanical damaging devices such as rams, hooks or wires carried in the same way, big calibre anti-aircraft guns firing shells sufficiently explosive to damage machines even without actually hitting them, are among the many suggestions put forward.

### The 200-inch Reflector

IT is stated by the New York correspondent of *The Times* that the 200-inch disk began its 3,300-mile railway journey from Corning, New York to Pasadena on March 26. It is encased in a steel crate weighing 10 tons, with the face of the disk protected by a 4-inch blanket of cork, and its rim by five layers of heavy felt, and is being carried on edge in a specially designed truck. The weight of the crated disk is supported by steel beams covered with cushions of compressed cork. The accompanying illustration (Fig. 1), reproduced from the article by Dr. George E. Hale on the 200-inch telescope which was

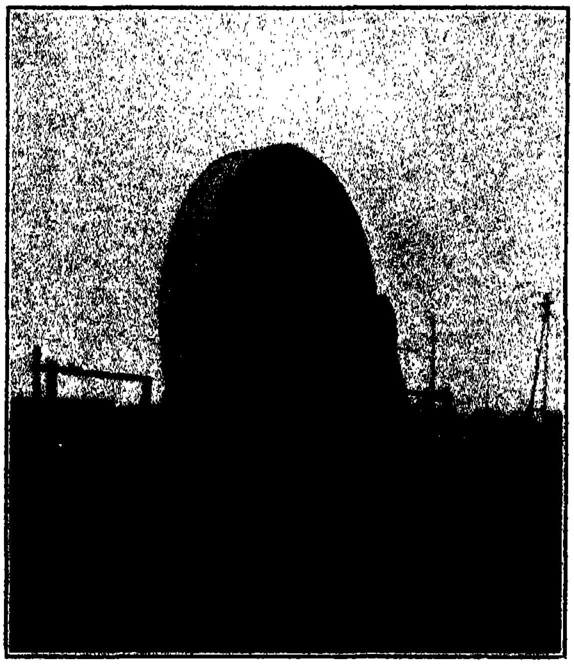

FIG. 1. Base of tube for 200-inch telescope.

published as a Supplement to NATURE of February 8, will bring home better than words the transport difficulties involved. The train will not travel faster than 25 miles an hour; the greatest care will have to be exercised, because the bottom edge of the crate is only six inches above the level of the rails, and at certain tunnels and bridges the top will have a clearance of only three inches. The news of the safe arrival of the disk at Palomar Mountain will be awaited with anxiety.

### Sir Patrick Laidlaw, F.R.S.

SIR PATRICK LAIDLAW has been appointed by the Medical Research Council to be deputy director of the National Institute for Medical Research, and head of the Department of Pathology and Bacteriology, in succession to the late Capt. S. R. Douglas. Sir Patrick has been a member of the Council's scientific staff at the National Institute since 1922, before which he was lecturer in pathology at Guy's Hospital. He received the Royal Medal of the Royal Society in 1933, and was knighted in 1935. He has latterly been engaged chiefly in the investigation of diseases

of man and animals due to infection with ultra-microscopic viruses. His successful work on the cause and prevention of dog distemper, supported by the *Field* Distemper Fund, is well known. More recently he and his colleagues have demonstrated the presence of a virus in human influenza, and have opened up an experimental line of attack upon this disease by which it is hoped to obtain important results.

### Pavlov and the Spirit of Science

A CORRESPONDENT has sent us the following translation of a note under the title "Bequest of Pavlov to the Academic Youth of his Country", written a few days before his death by Prof. I. P. Pavlov for a student magazine entitled *The Generation of the Victors*: "What shall I wish for the young students of my country? First of all sequence, consequence and again consequence. In gaining knowledge you must accustom yourself to the strictest sequence. You must be familiar with the very ground-work of science before you try to climb the heights. Never start on the 'next' before you have mastered the 'previous'. Do not try to conceal the short-comings of your knowledge by guesses and hypotheses. Accustom yourself to the roughest and simplest scientific tools. Perfect as the wing of a bird may be, it will never enable the bird to fly if unsupported by the air. Facts are the air of science. Without them the man of science can never rise. Without them your theories are vain surmises. But while you are studying, observing, experimenting, do not remain content with the surface of things. Do not become a mere recorder of facts, but try to penetrate to the mystery of their origin. Seek obstinately for the laws that govern them. And then—modesty. Never think you know all. Though others may flatter you, retain the courage to say, 'I am ignorant'. Never be proud. And lastly, science must be your passion. Remember that science claims a man's whole life. Had he two lives they would not suffice. Science demands an undivided allegiance from its followers. In your work and in your research there must always be passion."

### Paint Research Station, Teddington

ON Tuesday, May 19, the Right Hon. James Ramsay MacDonald, M.P., Lord President of the Council, will open the new buildings of the Paint Research Station, Teddington. The Research Association of British Paint, Colour and Varnish Manufacturers, incorporated in 1926, under the presidency of Mr. S. K. Thornley, really began its investigation work in a private laboratory, but soon, in May 1927, occupied a small converted factory at Teddington. Many alterations and additions were necessary, and in 1930 a substantial new block was added to the old building. In the autumn of 1935 a further extension, which Mr. MacDonald will open, was completed; altogether there is now extensive and admirable laboratory accommodation for chemical, physical and technical work, as well as a large library offering excellent reference facilities on all matters bearing upon the related industries. The Association is co-operatively financed with the assistance of the Department of Scientific and Industrial Research, and in common with other and similar research associations has for its aim the application of scientific knowledge and methods to the problems of the industries concerned, which range from paint to printing ink, pigments, varnishes, linoleum and the like. The work up to recent times has been mainly concerned with problems arising out of development and control of manufacture; but a special division has now been formed for the study of paint application problems, with a corresponding extension of interest to architects, builders and decorators. The original research work carried out at the Paint Research Station is, from time to time, set out in the form of technical papers and bulletins, of which some ninety have been issued to date. In addition, a comprehensive "Abstract Review of Current Literature in the Paint, Varnish and Allied Industries" is published and is available to interested people; as a reference journal on paint matters this "Abstract Review" is unique.

### Technique of Low Temperature Investigation

THE first lecture of the series arranged in connexion with the Very Low Temperatures Exhibition, at the Science Museum, South Kensington, was delivered in the Lecture Theatre of the Museum on Wednesday, April 1, by Prof. M. W. Travers, of the University of Bristol, the title being "The Technique of Low Temperature Investigation". Prof. Travers spoke with the authority of a pioneer, having been associated with Sir William Ramsay in the discovery of neon and other rare gases in experiments carried out at University College, London. These discoveries were the outcome of investigations at low temperatures and have resulted in the familiar neon signs and other forms of modern illumination. In tracing the work of various investigators from the time of Michael Faraday, Prof. Travers explained in a popular way with numerous experimental demonstrations the methods by which very low temperatures are attained. Admission to these lectures is by ticket obtainable free of charge from the Museum.

### Recent Acquisitions at the Natural History Museum

AMONGST recent acquisitions to the Zoological Department are the skin and skull of a forest hog (*Hylochoerus meinertzhageni*) from the Aberdare Mountains, Kenya Colony, presented by Mr. W. B. Cotton. Other additions include four wild cats from Argyllshire, presented by Mr. Ernest Baker, a lion skin from British Somaliland, presented by Mr. F. J. E. Manners Smith, the skin of a genet from Mpika, Northern Rhodesia, presented by Capt. C. R. P. Henderson, and the skin and skull of a tahr (*Hemitragus hylocrius*) from the Nilgiri Hills, presented by Major E. G. Phythian-Adams. Among the purchases are two hundred mammals and birds from Jugoslavia, a country from which the Museum possesses very little material. The Mineral Department

has received by gift from Mr. S. R. Mitchell crystals and platy aggregates of the hydrous magnesium phosphate, newberyite, from the guano deposits of the Skipton Caves, near Ballarat, Victoria, and from Capt. R. S. Pain a fine collection of doubly terminated quartz crystals, variously coloured, from a gypsum hill in the Salt Range, Punjab. Asbestos has been presented by Mr. L. G. Brandon-Fleming from India, and by the Griqualand Exploration and Finance Co. from its mines in Griqualand West. Lady Kleinwort has given a fine stalactite from the Mammoth Caves in Kentucky. The purchases include a magnificent group of crystals of tarnowitzite, the variety of aragonite containing lead carbonate, from Tsumeb in South-West Africa, and a large group and a large twin plate of selenite, the crystallised form of gypsum.

### Imperial Forestry Institute, Oxford

The Imperial Forestry Institute was established in 1924 at Oxford and placed under the direction of the professor of forestry—the School of Forestry and the Institute being kept separate. In the eleventh annual report (Hollywell Press, Oxford, 1935) it is announced that, owing to the work of the Institute having greatly increased, a new appointment of director of the Institute alone has been made, the Oxford professor of forestry remaining as general head of the Department and to remain in general administrative charge of the School and the Institute. Mr. J. N. Oliphant, deputy director of forestry, Malaya, has been appointed to the new post. It is stated in the report that "With a revival of recruitment for the forest services the number [of students at the Institute] may be expected to approach the normal once more". Among the research work undertaken is the investigation into the cricket-bat willow. It is to be hoped that something definite and practical may come out of this work to assist landowners in Great Britain possessing areas eminently suited to the growth of the willow. The report mentions an estate where five hundred specimens of a well-known hybrid were supplied fifteen years ago; it being discovered years afterwards that they were not the true *Salix coerulea*. The present writer knows of a case, now twenty-five years old, where a much larger number of a so-called cricket-bat willow were planted with a considerable financial loss to the estate. The owner wants a practical remedy. Another investigation is with the elm. The report says: "The elm studies begun by Dr. Bancroft in 1933 have been continued in the Cotentin region of Lower Normandy, the south of England, the east of Scotland, and in S.W. Ireland; the later investigations have been concerned more particularly with the origin of the English elm, *Ulmus campestris*, and of the Guernsey elm, *Ulmus stricta* var. *sarniensis*. Interesting observations were made in the Cotentin in July 1935, concerning the connexion between habit-type and climatic conditions, the effect of growth-conditions on the quality of the timber, and the effect of the introduction of *Ulmus montana* Stokes in the neighbourhood of Bricquebec."

### Inexhaustibility of Oil Resources in America

Science Service of Washington, D.C., reports that Mr. A. J. Byles, president of the American Petroleum Institute, assured members at their sixteenth annual meeting that exhaustion of American petroleum and products was beyond the limits of man's powers of prediction. During the last decade, a number of facts pointing to their inexhaustibility have come to light. Proved reserves are now estimated at twice the amount they were in 1925, in spite of the volume of oil withdrawn. Oil has been found at greater depths, and in some cases even below old pools; moreover, there still remain unexplored more than a billion acres of geological formations which may prove to be oil-bearing. Deposits of bituminous coal are to all intents and purposes unlimited, and these can be drawn upon if necessary to meet the demand for motor fuel. Further, more than a hundred billion barrels of oil are said to be obtainable from shale oil deposits. Improved scientific methods of discovery and production have facilitated greater recovery of oil per well and more economical usage of oil. Mr. Byles expressed the view that rumours of oil scarcity were spread merely in order to frighten people into advocation of federal control of the industry.

### Pollen Grains

Miss Annie D. Betts, editor of *The Bee World*, writing with reference to the reviewer's comment on the "lack of comprehensive works" in discussing Wodehouse's "Pollen Grains" (Nature, Feb. 22, p. 294), has directed our attention to two recent works dealing with pollen, which, though primarily designed for the purpose of identifying pollen grains in honey, may be of use in other spheres of pollen study. These works are: Armbruster, "Pollenformen und Honigherkunftsbestimmung" (1929, and a supplement 1935); Zander, "Pollengestaltung und Herkunftsbestimmung bei Blütenhonig". The first-mentioned publication contains drawings of the pollen of more than 1,200 species of plants; the second has photographs of more than 700 species.

### Dovedale

The Pilgrim Trust has just presented important areas on both banks of the Dove to the National Trust. The Bostern Estate of 415 acres has been acquired from Lord Daresbury, and of this about 165 acres of the Derbyshire slopes of Dovedale will become the property of the Trust. The estate is in the heart of Dovedale and includes Bayley Hill and Bostern Nab—both over 1,000 ft., with views extending to Kinder Scout, Axe Edge moors and Chelmorton Low to the north, and the hills of Staffordshire and south Derbyshire to the south. The other area acquired through the generosity of the Pilgrim Trust lies on the Staffordshire bank farther north and comprises the Alstonefield Glebe land of 70 acres with a long frontage to the Dove and the more austere beauties of upper Dovedale. It is opposite Biggin Dale and the Iron Tors presented by Mr. R. McDougall and Mr. Kerfoot. The new property adjoins Wolfscote Dale and includes Peasland Rocks

and Gipsy Bank, and was bought from the Rev. S. Beresford with the consent of the Ecclesiastical Commissioners.

### Announcements

SIR ARTHUR HILL, director of the Royal Botanic Gardens, Kew, has been awarded the Grande Médaille à l'effigie d'Isidore Geoffroy St. Hilaire, by the Société Nationale d'Acclimatation de France, which is the highest honour the Society accords. Dr. V. Van Straelen, director of the Royal Museum of Natural History, Brussels, also received the medal.

THE President of the French Republic has been pleased to confer upon Sir Henry Wellcome la Croix d'Officier de la Légion d'Honneur. This decoration is a further tribute to British medical and chemical research, to which Sir Henry has made notable contributions.

THE Council of the Iron and Steel Institute has awarded the Andrew Carnegie Gold Medal for 1935 to Dr. D. F. Marshall, of Sheffield, for his paper on "Further Determinations of the External Heat Loss of Blast-Furnaces". The Andrew Carnegie Gold Medal is awarded to the author of that report of work carried out with the aid of a grant from the Andrew Carnegie Research Fund which, in the Council's opinion, is the best of those published during the year. It is interesting to note that in 1933 the Williams Prize was awarded jointly to Dr. Marshall for his paper on "The External Heat Loss of a Blast-Furnace", in which the author presented the results of a research of which his Carnegie report recorded the continuation.

THE Council of the Royal Society of Edinburgh has nominated Prof. J. Graham Kerr, M.P., and Prof. James Ritchie to represent the Society on the International Committee for Bird Preservation, British Section.

MR. E. J. ROBERTS, lecturer in agriculture at the University College of North Wales, Bangor, has, by the courtesy of the College, been seconded for a period of a year for service with the Agricultural Research Council as crop drying investigator. During the forthcoming grass drying season, Mr. Roberts will be engaged in collecting data regarding grass drying plants in operation in England and Wales and in Scotland, and it is hoped that on the completion of his investigation it may be possible to publish comprehensive information for the use of farmers who are contemplating the purchase of a crop drier.

IT is announced that the Academic Assistance Council has received a donation of £1,000 from the executors of Miss Ida Benecke, for the general purpose of assisting displaced scholars and scientific workers.

Two earthquakes of moderate intensity were recorded at Kew Observatory on March 25. The first impulses of the earlier shock arrived at 8 hr. 46 min. 5 sec. G.M.T. and those of the latter shock at 9 hr. 3 min. 15 sec. G.M.T. The records show that both the earthquakes occurred under the North Atlantic, south-west of Iceland and about 1,250 miles north-west of Kew.

THE German Hay Fever Association has organised a scientific centre at Cologne for the study of allergic diseases.

THE fiftieth anniversary of the English Goethe Society, which was founded on February 25, 1886, under the presidency of Prof. Max Müller for the purpose of promoting the study of Goethe's works and thought, was celebrated on February 26 by a conversazione at University College, London. After a reception by the president, Prof. G. P. Gooch, an address was delivered by Prof. H. G. Fiedler, of Oxford, entitled "Memories of Fifty Years of the Goethe Society". A volume of the Society's proceedings is published annually under the editorship of the honorary secretary, Prof. L. A. Willoughby. Further information can be obtained from the assistant secretary, Miss Ella Oswald, 3 Steele's Road, N.W.3.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A research chemist in the Department of Clinical Investigations and Research, Royal Infirmary, Manchester—The Director (April 17).

A principal of the Constantine Technical College—Director of Education, Education Offices, Middlesbrough (April 18).

A lecturer in electrical technology in Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (April 18).

A University lecturer in mathematics in the University of Cambridge—Dr. S. Goldstein, St. John's College (April 20).

Demonstrators in inorganic and physical chemistry, physics and physiology in Bedford College for Women, Regent's Park, N.W.1—The Secretary (April 25).

A Government meteorologist and an Assistant meteorologist to the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (April 30).

A professor of psychology and a professor of sociology in the University of the Witwatersrand—The High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (April 30).

A professor of anatomy in the University of Leeds—The Registrar (April 30).

An assistant civil engineer for the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4051).

A librarian and information officer to the Research Association of British Flour-Millers—The Director of Research, Old London Road, St. Albans.

A botanist and a chemist at the Board of Greenkeeping Research, St. Ives Research Station, Bingley, Yorks—The Director.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 583.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Carbon Dioxide Content of Atmospheric Air

DURING the last nine months of his life my father, Prof. J. S. Haldane, was engaged, in collaboration with Dr. R. H. Makgill, in the systematic analysis of atmospheric air. Owing to his death and the absence of Dr. Makgill in New Zealand, some time may elapse before the full results of their work are published. But certain of them are of enough general interest to warrant a preliminary note.

The apparatus used was an improved form of the well-known Haldane volumetric gas analysis apparatus, adapted for the estimation of carbon dioxide only. The measuring burette, control burette, and carbon dioxide absorption bulb are all immersed in the same water bath, and their connexions are greatly shortened. 20 c.c. of air is used for each analysis. If the proper precautions are taken, duplicate estimations of carbon dioxide always agree within 2 volumes per 100,000, and generally within 1 volume. A single analysis can be completed in ten minutes. The apparatus is made by Messrs. Siebe Gorman and Co., Ltd., 187 Westminster Bridge Road, S.E.1. About 1,500 analyses of atmospheric air have been made with it. It has also been used for experiments on photosynthesis and plant respiration, and on the gases in equilibrium with river, spring and sea water. In what follows the carbon dioxide content is given throughout in volumes per 100,000.

The amount of carbon dioxide in country air at heights from 4 ft. to 70 ft. above ground-level varied between 21 and 44 volumes. The diurnal variation due to photosynthesis was very marked from July, when systematic observations began, until October. But in December no definite diurnal periodicity was observed. Thus the average of 153 analyses made at Cloan (Perthshire) during August 1935 was 32·4 volumes, that of 15 made at night was 38·6. The maximum fall due to the photosynthesis was observed when bright sunshine followed rain. In dry weather, sunshine had but little effect. It seems likely that during drought the stomata of leaves are nearly closed so as to conserve water, and carbon dioxide is thus excluded.

The exhalation of carbon dioxide from the soil was very obvious. 23 pairs of samples were taken simultaneously at ground-level on bare tilled soil and at a height of 4½ ft. The carbon dioxide at ground-level was higher on 19 occasions, equal on one, and lower on three. The mean excess was 5·4 volumes per 100,000. Samples taken from holes about 3 cm. below the surface contained as much as 100 volumes. The carbon dioxide excess persisted even among grass during sunshine, though low values were found in a mass of creeper on a wall. The influence of combustion was equally clear. Eighteen samples taken during still weather in London, and analysed by Mr. W. J. A. Butterfield, ranged from 42·5 to 90 volumes of carbon dioxide per 100,000, averaging 65.

A possibly more important influence, at least in Britain, is that of the sea. Samples of air blowing inland off the sea on to the coast of Ayrshire in August and September averaged 37 volumes of carbon dioxide. On the other hand, samples taken by Commander G. C. C. Damant on the southern shore of the Isle of Wight in November during southerly breezes averaged 27 volumes. It is generally thought that the sea round the British Isles acts as a sink for carbon dioxide. The Ayrshire observations suggest that this is not always the case.

The carbon dioxide content of the air also varied for causes which are at present uncertain. Thus during October, the night air at Oxford generally contained 32–34 volumes. From October 31 until November 8 it ranged from 35 to 42, averaging 38. This was a period of successive cyclonic depressions.

It appears that this method, which is much more rapid than the gravimetric or alkalimetric methods, and at least equally reliable, while it only requires a simple portable apparatus, may prove of considerable value for three purposes. It may furnish new data for plant ecology. Thus grass appears to carry out photosynthesis in an atmosphere distinctly richer in carbon dioxide than tree leaves in the same area; and my father conjectured that, at least in the temperate zone in summer, the carbon dioxide concentration of the air might be considerably lower in the interior of continents than near the coast. It could probably be used for the investigation of stratospheric air. A similar apparatus could estimate oxygen with less absolute accuracy, but almost equal sensitivity to small differences. Finally, it might be of value to meteorologists in distinguishing between bodies of air of different origins.

J. B. S. HALDANE.

Cherwell, Oxford.
March 15.

## Surface Layers of Crystals

THE explanation of pyro-electric excitation in crystals, obviously extending to piezo-electric, as strain of a natural internal polarisation after the manner of Poisson and Kelvin, is one of the beautiful basic ideas in polarised electrics.

A crystal consists of a series of layers of ions, parallel to a face, alternately positive and negative, whether they are free ions or the directed poles of atoms. Fifteen years ago, I set out the relevant analysis which had long been running in my mind, the main result emerging that if the layers are equidistant the resulting electric field for a plate is that due to half the first layer and half the final layer. According to the Kelvin idea, this field would become abolished by accumulation along the surface of foreign cancelling ions, of whatever kind, if of opposing sign; an equilibrium which thermal expansion would disturb, with pyro-electric results. The result as here stated is

established by replacing each ionic stratum by a thicker one, swollen out so that they overlap with the superposed parts equal and opposite. This is after the manner of the Young-Fresnel argument for optical diffraction by a slit, which makes the result due to initial and final fractions of the Huygenian zones. But this result cannot be all, for these terminal half strata are not affected by change of temperature, or rather are affected only in definite manner by the superficial expansion of the layer thereby caused. There is in addition the internal Poisson-Kelvin polarisation, and change of its intensity-moment by thermal expansion alters the electric field by known laws: there may be such local change of polarisation also in the replacing of the strata as above by thicker internally cancelling strata.

A question may open out here as to how the pyro-electric effect is divided between these two causes. But the feature now in front of us is the very great number of compensating ions in this surface layer and the great aggregate of their charges: so much so that I only half believed in the result which I found to be inevitable[1], and nobody else took any notice of it at all. But now, in the fundamental domain of atomic diffraction detected by Davisson and developed rapidly in technique and results in the school of G. P. Thomson, the case stands differently. For a diffraction by just such a single surface layer, usually the halved sheet of the simple case of equidistant internal strata here considered, has been established: and though the rapid progress of the subject naturally detects also more complex compensating ionic sheets of equidistant internal strata, I do not discover that any reason has been offered for their structure.

I refrain from further speculation on this very important and progressive experimental subject. The gradualness of transition between consistent phases of fluid[2] is another case where simple theory may assist.

May I be permitted, however, now to sketch a somewhat wild speculation; though scarcely wilder than the relevant accepted facts, most recently gained along the line of the present rapid radioactive advance, by the initiatives of the Curie-Joliots, of Fermi, and of Chadwick. A main new feature is that if crystalline dust of light elements such as boron or lithium is mixed with a gaseous radioactive product there is emitted a stream of particles proved to be of the same mass as the proton, but absolutely without electrodynamic origin for that mass. A new possibility here introduced is that the active gas may condense as a surface film, as above, on the small crystals, forming a close layer, so that a casual atomic explosion or encounter may there involve more than two interacting particles; but this merely points out a difference of type in the new technique, it does not suggest how it can be effective in the direction required. The conclusion that very rapid particles of about the same (protonic) mass may be of different kinds, of electric type or not, tends to subvert the historic simple mode of theory of the electrodynamic field and the interlocking singularities from which the field of strain obtains its terminal support. It is in this revolutionary regard to be classed with the recently discovered diffraction of uncharged atom-streams.

JOSEPH LARMOR.

Holywood,
Northern Ireland.
Feb. 26.

[1] *Proc. Roy. Soc.*, A (1921); reprinted in "Math. and Phys. Papers", 2, 630 (1928).
[2] *loc. cit.*, 611, xxiv.

## Heat Denaturation of Proteins as a Chain Reaction

BLOOD coagulation, which is a special case of protein denaturation, has been found to be a chain reaction by which a new reacting substance is formed[1]. By the action of heat on a mono-disperse system of highly purified serum-globulin in a salt solution, a similar reaction was found to take place. The denaturation process was followed by means of nephelometric measurements with a Pulfrich photometer. The denaturation was limited to a time of exposure to heat (waterbath at 70° C.) by which the coagulated denatured particles of proteins are assumed to remain practically of the same size[2]. It could therefore be assumed that the nephelometric values expressed the real amounts of proteins denaturated.

The curve indicating the first part of the denaturation process is exponential. At a constant temperature of 70° C. the time was estimated as that which was required for a genuine globulin solution to reach an arbitrary opalescence (nephelometric value $x$). A certain small amount of a globulin solution ($A$), which had already been partly denaturated at 70° C., was added to a tube with a solution of genuine globulin ($B$). The solution $B$ was then placed in the waterbath at 70° C. It was found that the denaturation curve was different from $A$. The velocity of the denaturation was faster from the very beginning. The chosen opalescence $x$ for $B$ was reached in a much shorter time than $A$. The initial nephelometric value of $B$ was naturally a little higher than $A$ but insufficient to explain the course of the process. Further, it was found that the course of the denaturation process is determined by the properties of the denaturated proteins transferred to the solutions of genuine globulin. When samples of $A$ were taken out from a denaturating globulin solution at different times during the process and added to new solutions of genuine globulin ($B$), the curves indicating the denaturation process of the $B$ systems are found to be similar to the reaction going on in $A$ at the very moment of the transfer. When transferred from $A$ at the beginning of the process, the curve of $B$ will be rather flat; taken out from $A$ at the time when the speed of the process is very fast, the curve of $B$ will rise immediately very steeply; and if transferred at the end of the denaturation, the $B$ curve will again begin very flat.

From earlier work[3] on the binding of heparin to proteins, we know that basic groups appear during the denaturation of the proteins, groups which were not available before. By elimination of some of the $NH_2$ groups by the addition to the genuine protein solutions of very small amounts of formaldehyde, or reducing the effect of the $NH_2$ groups by addition of small amounts of alkali, the denaturation process may be either retarded or perfectly inhibited. These facts give further support for the assumption that certain amino-groups play an essential role in denaturation. Therefore there seems to be no real indication of being able to explain the mechanism of denaturation by a hitherto unverified process of hydration or hydrolysis, as suggested by Chick and Martin[4].

The protein molecule may tentatively be regarded as an approximately spherical body (Svedberg[5], Astbury[6]), of which the surface layer of atoms and radicals plays an essential role in the reactions of the molecule. The structure of this surface layer may be affected by forces exerted by the interior parts of

the molecule, by the surrounding medium and by neighbouring molecules approaching a state of equilibrium depending also on temperature. According to this picture, the denaturation process may be explained in the following way. The appearance on the surface of the molecule of basic groups from its interior may be the essential reaction in the denaturation. By such means, the molecules react with each other and form an irreversible reaction product whereby even new peptide chains may arise. The same explanation would apply to the appearance of the –SH groups in denaturation. Further, it may be possible that the high temperature coefficient in the heat denaturation of proteins is due rather to steric changes of the molecule than to the more improbable explanation of a very large critical increment given as 130,000 calories[6].

ALBERT FISCHER.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
Feb. 6.

[1] Fischer, A., NATURE, 135, 1075 (1935).
[2] Clark, J. H., *J. Gen. physiol.*, 19, 199 (1935).
[3] Fischer, A., *Biochem. Z.*, 278, 133 (1935).
[4] Chick, H., and Martin, C. J., *J. Physiol.*, 45, 61 (1913).
[5] Svedberg, T., *Kolloid Z.*, 51, 10 (1930).
[6] Astbury, W., Dickinson, S., and Bailey, K., *Biochem. Z.*, 29, 2351 (1935).

## Structures and Formulæ of the Prussian Blues and Related Compounds

ALTHOUGH prussian blue has been known since 1704, and has long been an important pigment, its chemistry has never been satisfactorily explained. The whole subject is surprisingly confused in spite of the large volume of work which has been published. The structures of prussian blue and of some associated compounds have recently been determined at this Company's Ardeer Factory by X-ray analysis. The powder method was used.

of all the alkali metals and ammonium, with the exceptions of lithium and cæsium, the atoms of which appear to be too small and too large respectively to enter this lattice easily. It is possible that the small cubes not containing alkali may contain water molecules.

In 'ruthenium purple'[1] the ferrous atom is replaced by divalent ruthenium. Here a similar class of compounds has also been shown to exist. The unit cube edge is 10·4 A. The formula is $Fe''' R Ru'' (CN)_6$.

The white ferrous-alkali ferrocyanides, which are intermediate compounds in the preparation of commercial blues, have been shown to be yet another class of compounds. The formula here is $Fe'' R_2 Fe'' (CN)_6$, where R represents Na, K, $NH_4$, Rb or Cs. The structure of this series is again cubic, $a = 5 \cdot 1$ A., and is closely related to that of the prussian blues. The general outline is the same, but now all the iron atoms are ferrous, and all cubes now contain an alkali atom (Fig. 1).

The structure of Berlin green, the oxidation product of prussian blue, has also been determined. The formula is $Fe''' Fe''' (CN)_6$, namely, that of ferric ferricyanide. This structure also is very similar to that of prussian blue; but here all the iron atoms are ferric, and there are no alkali atoms present (Fig. 3). The unit cell is again 5·1 A., and it is possible that water occurs in the small cubes.

The cupriferricyanides, $Cu'' R Fe''' (CN)_6$, are found to exist, and have the same structure as the prussian blues, with cupric copper replacing ferrous iron. The edge of the unit cube is here slightly less than 10·2 A.

These results have all been checked by chemical analysis.

These three types of structure form an extremely interesting series, as, starting with ferrous-alkali ferrocyanide, this compound oxidises very easily to prussian blue, which in turn may be oxidised to

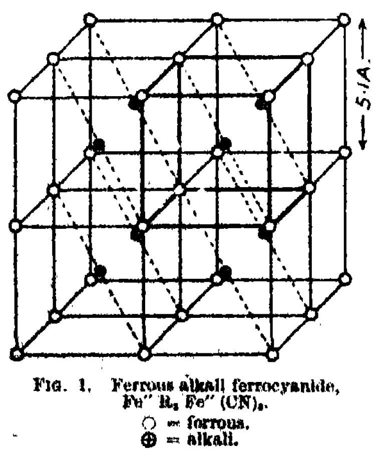


FIG. 1. Ferrous alkali ferrocyanide, $Fe'' R_2 Fe'' (CN)_6$.
○ = ferrous.
⊕ = alkali.

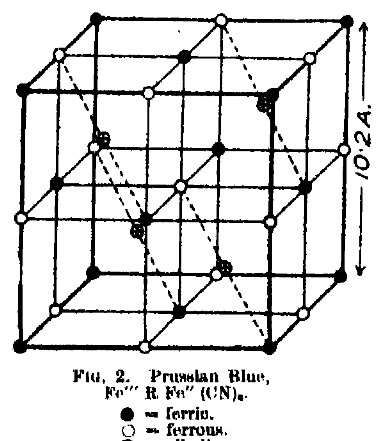


FIG. 2. Prussian Blue, $Fe''' R Fe'' (CN)_6$.
● = ferric.
○ = ferrous.
⊕ = alkali.

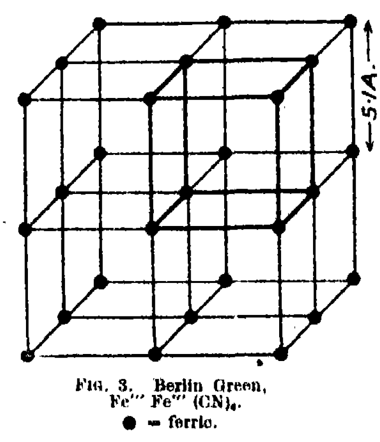


FIG. 3. Berlin Green, $Fe''' Fe''' (CN)_6$.
● = ferric.

In the case of the blue, a class of definite compounds is shown to exist, the formula being $Fe''' R Fe'' (CN)_6$, where R represents an alkali metal or ammonia. Commercial pigments all tend to be of this type. The structure is cubic, $a = 10 \cdot 2$ A., and is illustrated in Fig. 2. The iron atoms are arranged, ferrous and ferric alternately, at the corners of a cubic lattice of 5·1 A. edge, and the CN groups lie in the edges of these small cubes. The alkali atoms occur at the centres of alternate small cubes. In this class are compounds

Berlin green. Thus, from a lattice of ferrous atoms linked by CN groups, with an alkali atom at the centre of each small cube (Fig. 1), alternate alkali atoms are removed and alternate iron atoms become ferric on oxidation to prussian blue (Fig. 2), whilst on further oxidation to Berlin green the remaining alkali atoms are removed and all the iron atoms become ferric (Fig. 3). Throughout all this, the same iron-cyanogen skeleton structure remains, except for very slight changes in the Fe–Fe distances, which alter

the lattice spacing slightly, whilst the blue colour is formed and then destroyed again. A detailed account cannot be given here, but it may be stated that there is also a slight variation in lattice spacing between members of each class, owing to the differences in size of the alkali atoms.

In addition, blues containing no alkali have been prepared, and X-ray photographs show that the Fe–CN skeleton structure is cubic and similar to that already described. ($a = 10 \cdot 2$ A. approx.) Here it seems that additional iron, or iron in combination with a negative ion, can replace the alkali metal. The water content of these blues is unusually high.

The unoxidised analogues of these alkali-free blues have a structure different from any yet described, and are at present under examination. The exact measurement of lattice spacings, water contents, etc., is now proceeding. It is hoped to publish this work elsewhere in more detail.

Most of the analyses were made in the Company's Dyestuffs Laboratory at Blackley.

J. F. KEGGIN.
F. D. MILES.

Research Laboratories,
Imperial Chemical Industries Ltd.,
Ardeer,
Ayrshire.
Feb. 29.

[1] Howe, *J. Amer. Chem. Soc.*, 18, 983 (1896).

## The Ultra-Violet Spectrum of Hæmoglobin Derivatives and Bile Pigment

As a result of numerous investigations of the ultra-violet spectrum of hæmoglobin and its derivatives, the location of an absorption band in the region of 4100 A. has been established for these compounds. It appears to be due to the hæm radical, and is independent of the nature of the globin fraction.

The ultra-violet spectrum has been quantitatively investigated by me of a number of hæmoglobin compounds which have all been prepared from recrystallised horse hæmoglobin. Those investigated were: oxyhæmoglobin, reduced hæmoglobin, neutral methæmoglobin, alkaline methæmoglobin, carboxyhæmoglobin, acid hæmatin, alkaline hæmatin (in aqueous and alcoholic solutions), reduced alkaline hæmatin, pyridine hæmochromogen, oxidised alkaline hæmatin pyridine, piperidine hæmochromogen and hæmatoporphyrin. All show the characteristic band in the region of 4100 A., although the position of the band is slightly shifted in some of the compounds. The solvents also have a slight influence on the position of the main band. However, its general form and position appears centred at 4100 A. This band is obviously not influenced by the presence of the globin fraction as the hæmoglobin and hæmatin spectrum are quite similar. Nor does the iron in the molecule in any state of oxidation exert any effect since hæmatoporphyrin, the iron-free derivative, has essentially the same absorption spectrum as hæmoglobin.

On the other hand, the ultra-violet absorption of pure bilirubin reveals a very different spectrum. There is no characteristic band at 4100 A. but a rather indefinite absorption extending from 5000 A. to around 4300 A.

Attempts to correlate the structure of the hæm radical and its ultra-violet spectrum are not numerous. Holden and Hicks[1] postulate that the main absorption band is present only when the pigment molecules are widely separated or when the valencies of the iron atom are fully utilised. Certainly, solution of the pigments in different solvents with the resultant change in dispersion influences the spectrum of the hæm pigments, but only to a slight degree, and does not explain the presence of the band as a characteristic of the hæm radical. It is impossible to cause the absorption band to disappear by changing the dispersion of the pigment. The only condition under which it will disappear is to convert the hæm nucleus into a bile pigment which involves molecular rearrangement.

A study of our results leads to the hypothesis that the absorption band at 4100 A. in hæm compounds is due to the porphyrin ring system made up of four substituted pyrrol nuclei. In the bilirubin, which is formed by the breakdown of the hæm molecule, the porphyrin ring system is opened into a straight chain of substituted pyrrol nuclei and the absorption which is characteristic of the ring system disappears.

Investigation of the ultra-violet spectrum of other bile pigments is being undertaken in order to confirm this hypothesis.

G. A. ADAMS.

Department of Biochemistry,
University of Western Ontario,
Medical School,
London, Canada.
Feb. 5.

[1] Holden, H. F., and Hicks, C. S., *Aust. J. Exp. Biol. and Med. Sci.*, 10, 219 (1932).

## Induced Radioactivity of Nickel and Tin

IN the course of an investigation, it was found desirable to build Geiger-Müller counters with substances that are not activated by neutron bombardment. From the list given by Fermi[1] and his collaborators, nickel and tin were selected as the most suitable elements that do not become radioactive when bombarded with neutrons.

When such counters were filled with air and irradiated with slow neutrons from a radon-beryllium source of about 100 mc., they were found to show considerable activity. The following half-life periods were found:

$$\text{Ni} : 3^{h} \pm 10^{m}.$$
$$\text{Sn} : 8^{m} \pm 2 ; \quad 18^{m} \pm 2.$$

Rotblat[2] reported very weak activity with a $20^{m}$ period when nickel is bombarded with fast neutrons. He irradiated a thin nickel sheet with a radon-beryllium source of 40 mc. and found an initial activity of 1·5 kicks a minute. With fast neutrons, we could, however, detect no activity either of nickel or of tin, even though sources up to 250 mc. were employed.

The initial activity of a nickel counter of 2 cm. diameter, 15 cm. long and with walls 0·5 mm. thick was about 60 kicks a minute above the zero count, of 40 a minute, when the irradiating source was about 100 mc. strong. With a similar source the initial activity of a tin counter of nearly the same dimensions was about 50 kicks a minute.

To compare these activities with that of a known active element, a tube of copper-nickel alloy, the copper content of which was chemically analysed and found to be 55 per cent, was made into a counter and irradiated with slow neutrons. The intensities

measured proved that the activities of nickel and tin were only of the order of one hundredth of the very highly water sensitive ($\alpha = 15$) $5^m$ period of copper. It became thus evident that the purity of the metals employed was of great importance.

To check whether the $180^m$ period of nickel was really different from $150^m$ periods of the neighbouring elements, cobalt and iron, a steel counter was activated and its decay period measured. The half-life thus determined was $154^m$, agreeing within the limits of precision with the value given by Fermi and others. From a number of determinations made with three different counters, it seems fairly certain that the $180^m$ period of active nickel is really different from the periods of its neighbours.

In the case of tin, the isotopes capable of being activated are probably 112, 122 and 124, and their combined relative abundance is only 12·3 per cent. Therefore the real activity of tin appears to be fairly strong. A rough estimation of the relative intensities of the two kinds of active nuclei showed that the activity with $18^m$ period is twice as strong as that with $8^m$ period.

The efficiency of this method of building counters with the substances to be studied as compared with that usually employed was roughly estimated in the following way. A thin-walled (0·042 gm./cm.$^2$) steel counter was itself activated and its activity measured. Then a tightly fitting cylindrical steel foil of the same thickness as the counter wall was activated separately and its activity measured by putting it around the counter in the usual way. It was found that the efficiency was enhanced by a factor of about 4 when the counter itself was activated.

R. NAIDU.

Birkbeck College,
London, E.C.4.

[1] Fermi *et al.*, *Proc. Roy. Soc.*, A, **149**, 522 (1935).
[2] J. Rotblat, NATURE, **136**, 515 (1935).

## Relation between Secondary Emission and Work Function

WHEN the work function of a metal is varied by depositing on its surface various amounts of a foreign substance (up to a complete monatomic layer), the ratio of secondary emission to primary current is found to change in the same sense as the thermionic emission, but to a much less degree. This difference of behaviour is due to the fact that the secondaries are emitted with velocities much greater than those of the thermally emitted electrons.

A quantitative estimate of the effect of variations of work function on secondary emission may be made on the basis of the known velocity distribution of secondary electrons. Using Haworth's data[1] for molybdenum, I have calculated the distribution of the normal components of energy, assuming the secondary emission at an angle $\theta$ to the normal[2] to be proportional to $\cos\theta$. The calculation shows that for secondaries having normal energies less than 5 electron-volts (a value which includes 52 per cent of the total number), the number $N$ having normal energy greater than $U$ may be represented approximately by the Maxwellian formula

$$\log_{10} N = A - bU,$$

where $A$ and $b$ are constants, the latter having the value 0·070 if $U$ is measured in electron-volts.

This equation gives the number of secondaries having sufficient normal energy to pass through a potential barrier, of magnitude $U$, parallel to the surface. Since any change in the work function of a given emitter is equal to the corresponding change in the potential barrier at its surface, the equation should describe equally well the variation of secondary emission with work function.

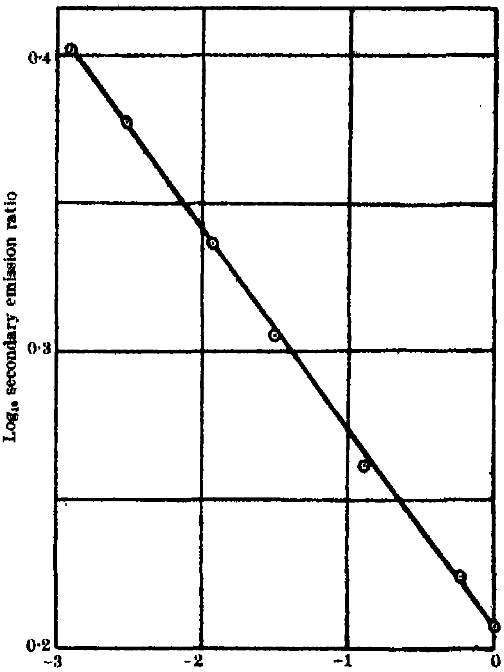


FIG. 1. Relation between secondary emission and work function for molybdenum contaminated with barium.

I have measured the secondary emission (at a primary voltage of 300) from a molybdenum filament with different degrees of barium surface contamination. The corresponding changes of work function were derived from contact potential measurements with respect to a clean tungsten filament. Fig. 1, which gives the results obtained for the lower degrees of contamination, shows that the law deduced above is accurately obeyed, the value obtained for $b$ being 0·067, which is in good agreement with the calculated value.

A similar relationship has been observed in the case of tungsten contaminated with oxygen, for which the secondary emission is less than that of the clean metal.

For atomically thick films, the above law was found to be inapplicable. This result might have been expected, since in this case a proportion of the secondaries arise in the film itself, whereas in the calculation it was assumed that the effect of the film was simply to modify the velocities of secondaries originating in the underlying metal.

It is hoped that a detailed account of these experiments will be published in due course.

L. R. G. TRELOAR.

Research Staff of the M.O. Valve Co.,
Research Laboratories of the
General Electric Co., Ltd.,
Wembley.

[1] L. J. Haworth, *Phys. Rev.*, **48**, 88 (1935).
[2] H. E. Farnsworth, *Phys. Rev.*, **31**, 414 (1928).

## Electron Emission of the Cathode of an Arc

IN the carbon- and tungsten-arc the electrons are in most cases emitted thermionically by the cathode, while in the mercury-arc (with mercury cathode) the cathode current is assumed to be due to the emission of electrons from a cold cathode by the high field before the cathode (field current). This high field is generated by the space charge of the positive ions flowing to the cathode.

I think there is still another way in which the cathode of an arc may in some cases emit electrons. If the metallic cathode of an arc (for example, an iron- or copper-arc) is, at least at some spots, covered with a thin layer of an insulator (thickness $10^{-4}$–$10^{-5}$ cm.), a number of positive ions on the surface of the insulator can give a high field near the metal, which will emit electrons through the insulator (field current); the electrons will enter the gas with a high velocity and only few of them will recombine with the ions on the surface. The greater part of the cathode drop will be present on the insulator, and the potential difference on the space charge layer in the gas will be small. (It may be that the breakdown of the insulator causes the wandering of the cathode spot of an arc in some cases.)

This mechanism is analogous to the mechanism of a low current discharge, discovered by Güntherschulze and Fricke[1]. If a carbon cathode is covered with a thin layer of an insulator, a glow discharge without Crookes's dark space is observed, called by those authors *Spritzentladung*. The potential difference on the discharge may be much less than the normal values of the cathode drop of a glow discharge. The electrons enter the gas with a velocity almost as great as is due to the potential difference on the insulator. If the insulator is mounted on a metal instead of on carbon, little sparks are seen on the cathode. This difference may be due to the lower electron concentration and the lower field current density in carbon, as compared with a metal.

M. J. DRUYVESTEYN.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland.
Jan. 6.

[1] *Z. Phys.*, **86**, 451 and 821 (1933); **92**, 728 (1934).

## Dissociation of Strong Electrolytes in Concentrated Solutions

IN the previous work of one of the authors, it was shown, by a study of the Raman effect, that while nitric acid[1] and sulphuric acid[2] progressively dissociate with dilution, the nitrates[3] are completely dissociated at all concentrations. The study has now been extended to a large number of strong electrolytes, and the results obtained indicate the following general characteristics:

(1) All the oxy-acids dissociate progressively with increasing dilution.

(2) The halogen acids, however, are completely dissociated even in concentrated solutions.

(3) The acid salts of the alkalis are completely dissociated into the alkali ion and the acid radical, the further dissociation of the latter being progressive.

(4) All other salts of the alkalis and alkaline earths are completely dissociated even in saturated solutions.

The explanation of the above results seems to be simple on the basis of the electronic theory of valency. The alkali and the alkaline earth elements, being strongly electrovalent, have their octet outer electronic structures easily completed, so that the stability of both the anions and the cations is great enough to prevent recombination of them into undissociated molecules. Thus, they are able to exist independently in the completely dissociated condition even in the crystalline state. In the state of solution, the dielectric constant of the solvent facilitates the further separation of these ions, which are, therefore, completely dissociated.

The hydrogen atom, however, is different from the alkalis in that it is capable of forming both the electrovalent and covalent bonds. This dual property of hydrogen enables it to form both types of molecules with the anions, those with the electrovalent link which are completely dissociated and others with the covalent link which are in the undissociated condition. At every concentration of the electrolyte, there is equilibrium between these two types of molecules. With decreasing concentration, this equilibrium changes, the molecules with the covalent link changing to those with the electrovalent link.

The exceptional behaviour of the halogen acids remains to be explained. It appears probable that the monovalent halogen ions, being more strongly electrovalent than the anions of the oxy-acids, can form only electrovalent or a very weak covalent bond with the hydrogen and hence are completely dissociated. The presence of Raman lines due to the undissociated molecules in the gaseous and liquefied state of these substances may be due to the weak covalent bond between the hydrogen and the halogens, which easily breaks up in the presence of a solvent of high dielectric constant.

Thus, though for dilute solutions, Debye was able to assume complete dissociation of all strong electrolytes, such a single generalisation does not seem to be possible for concentrated solutions. While all electrovalent bonds in strong electrolytes are completely broken down even in concentrated solutions, covalent bonds, possible only between the anions and the hydrogen ion, change progressively into the electrovalent type with dilution, which then leads to complete dissociation.

I. RAMAKRISHNA RAO.
C. SAMBASIVA RAO.

Andhra University,
Waltair, India.
Jan. 16.

[1] *Proc. Roy. Soc.*, A, **127**, 279 (1930).
[2] *Ind. J. Phys.*, **8**, 123 (1933).
[3] *Proc. Roy. Soc.*, A, **144**, 159 (1934).

## Exhibition of 'Autogenous' and 'Stenogamous' Characteristics by *Theobaldia subochrea*, Edwards (Diptera, Culicidæ)

OF the various idiosyncrasies of mosquitoes, laying fertile eggs without a previous meal of blood (autogeny) and mating within very small cages (stenogamy) are among the most unusual. Exhibitions of the former peculiarity have hitherto been provided exclusively by different 'strains' of the mosquito which Roubaud has named *Culex pipiens* var. *autogenicus*[1] but for which (as previously stated) we advocate the adoption of a different specific name[2]. The latter

peculiarity—stenogamy—is known to be a characteristic of the above-mentioned species and also of two others, namely, *Aedes aegypti* and *Anopheles maculipennis* var. *atroparvus*.

The following observations recently recorded in our laboratory in regard to the mosquito *Theobaldia subochrea*, Edwards, appear to be worthy of note. It may be mentioned that, in Great Britain, *T. subochrea* is one of the rarer species, having so far been recorded from eight localities only. These are Earl's Court (London), Hayling Island (Hants), Hull (Yorks), Isle of Sheppey (Kent), Letchworth (Herts), Rustington (Sussex), Southampton (Hants) and Studland (Dorset).

On February 1 and 15 last, we collected third-instar larvæ of *T. subochrea* in a brackish pond at Hayling Island. These larvæ (together with some of the water from the pond) were placed in the lower cylinder of a Moscon incubator; the upper cylinder of which (wherein the hatched-out adults forgather) has a volume of about 500 c.c. By the end of February there were six adults (five males and one female) in the upper cylinder. No meal of blood was given to the female.

On the morning of March 7 we found an egg-raft on the surface of the water in the lower cylinder. This raft was composed of 153 eggs, all but four of which hatched into larvæ during the afternoon of March 10.

These observations indicate that *Theobaldia subochrea* is both autogenous and stenogamous.

JOHN F. MARSHALL.
J. STALEY.
British Mosquito Control Institute,
Hayling Island, Hants.
March 14.

[1] E. Roubaud, *Ann. Sci. nat.*, (10), **16**, 5 (1933).
[2] J. F. Marshall and J. Staley, NATURE, **136**, 641 (1935).

## Transference of a Mite from Cyclamen to Strawberry

ON November 21, 1935, a number of cyclamen flowers were received from a nursery near Exeter, and were found to be heavily infested with *Tarsonemus pallidus*, Banks, which was causing injury typical of that normally associated with infestation by this mite. A few of these flowers were placed on the crown of a strawberry plant, which was kept in the laboratory. By the beginning of January 1936, the young leaves of this plant were showing symptoms typical of *Tarsonemus* damage. The plant was examined on January 7, and mites were seen to be plentiful between the folds of the young leaves. A more critical examination on January 9 resulted in the discovery of adult mites inside the crown as well as on the young leaves.

Ewing and Smith[1] have recently found that *Tarsonemus pallidus*, Banks, and *T. fragariæ*, Zimm., are synonymous. Under the former name, the mite is a pest of cyclamen, begonia, etc., both on the Continent, in America and in England. Under the latter name it has been regarded as a pest of strawberry only[2]. This is one of the few outbreaks of *T. pallidus* on cyclamen that has been reported in Great Britain for some years, though the mites apparently used to be very common on cyclamen and begonias grown commercially under glass.

The transference of *T. pallidus* from strawberry to cyclamen, begonia and raspberry has been attempted by Massee[3] without success. Ewing and Smith[1] recently established mites from strawberry on plants of *Cyclamen*, *Delphinium*, *Saintpaulia* and *Achyranthes*.

The present small experiment is believed to be the first successful demonstration of the ability of the mite to transfer from cyclamen to strawberry.

D. O. BOYD.
W. E. H. HODSON.
University,
Reading.
Feb. 12.

[1] Ewing, H. E., and Smith, F. F., "The European Tarsonemid Strawberry Mite identical with the American Cyclamen Mite", *Proc. Ent. Soc. Wash.*, **36**, No. 8–9, 267–268 (1935).
[2] Massee, A. M., "Further observations on the Strawberry Tarsonemid Mite (*Tarsonemus fragariae* Zimm.)", Ann. Rep. East Malling Res. Sta. 1932, 20, pp. 117–131 (1933).
[3] Massee, A. M., "Some Injurious and Beneficial Mites and Insects on Top and Soft Fruits", *J. Pomol. and Hort. Sci.*, **10**, No. 2, 106–129 (1932).

## A Nutritional Deficiency causing Gizzard Erosions in Chicks

IT has been demonstrated by Dam[1,2] and by us[3,4] that a dietary disease of chicks, in which the blood fails to clot in normal time and in which extensive hæmorrhage develops, is due to the lack of a new fat-soluble vitamin. Extensive erosion of the gizzard lining has been commonly noted in these investigations[1,2,3,4], but the occurrence of this latter disorder has not been closely correlated with incidence of the hæmorrhagic disease. Gizzard erosion has been frequently found in chickens given the usual practical diets[5]. Such erosions have also been observed at this laboratory in embryos in late incubation stages and in day-old chicks. On the other hand, the hæmorrhagic syndrome has not been reported in chickens reared under practical conditions. In view of these facts, we have investigated gizzard erosion with the object of determining whether it is a true portion of the hæmorrhagic syndrome or a separate disease not caused by deficiency of the anti-hæmorrhagic vitamin.

It was found that high levels of a hexane extract of dried kale or dried alfalfa caused an alleviation of gizzard erosion. Quantities of these extracts equivalent to one fourth per cent of dried substance were adequate in preventing deficiency of the anti-hæmorrhagic vitamin, and were shown by assay to be of nearly equal potency in this respect. However, the quantity of alfalfa extract required to prevent or cure gizzard erosion was about a hundred times the adequate anti-hæmorrhagic dosage, while the quantity of kale extract required was about twenty times the adequate anti-hæmorrhagic dosage. It was thus shown that the anti-gizzard-erosion activity of these extracts was not proportional to their anti-hæmorrhagic activity.

Afterwards, it was found that the non-saponifiable fraction of these extracts exerted no appreciable effect on gizzard erosion when fed at levels up to the equivalent of 40 per cent of dried substance, although these levels provided massive dosages of the anti-hæmorrhagic vitamin. Tests were then conducted with both the saponifiable and the non-saponifiable fractions of kale lipids and it was found that the anti-gizzard erosion activity was localised in the saponifiable fraction.

Other dietary supplements tested for potency in prevention of gizzard erosion and found negative were cod liver oil 5 per cent, wheat germ oil 5 per cent,

orange oil 0·5 per cent, fresh yellow carrots *ad. lib.*, fresh lemon juice 2 c.c. orally per bird per day, liver extract equivalent to 170 per cent, egg yolk and egg white, alfalfa ash equivalent to 25 per cent, glycerine 4 per cent, cotton pulp 5 per cent and sand 10 per cent. Thus it was shown that copious amounts of the known vitamins, including the anti-hæmorrhagic vitamin, were without influence on gizzard erosion.

Gizzard erosion is not a portion of the hæmorrhagic syndrome, but is a separate deficiency disease which may be corrected by a new fat-soluble factor found in the saponifiable fraction and probably vitamin in Nature. Studies on this anti-gizzard-erosion factor are being continued.

H. J. ALMQUIST.
E. L. R. STOKSTAD.

Division of Poultry Husbandry,
University of California,
Berkeley.

[1] Dam, H., NATURE, **135**, 652 (1935).
[2] Dam, H., *Biochem. J.*, **29**, 1273 (1935).
[3] Almquist, H. J., and Stokstad, E. L. R., NATURE, **136**, 31 (1935).
[4] Almquist, H. J., and Stokstad, E. L. R., *J. Biol. Chem.*, **111**, 105 (1935).
[5] Jungherr, E., *Conn. Agr. Exp. Sta. Bul.*, **202**, 52 (1935).

## Humic Composts and Inorganic Fertilisers

SIR ALBERT HOWARD'S lecture before the Royal Society of Arts on November 14 last on "The Manufacture of Humus by the Indore Process" has been followed by several inquiries as to the attitude of the Indore Institute of Plant Industry towards the question of the comparative value to crops of inorganic fertilisers and composts. It therefore seems desirable to define that attitude by a definite and public statement.

Regarding the maintenance of soil organic matter at its optimum level as one of the aims of soil management, we consider this can generally be best achieved by the use of humic composts. These are easily and cheaply made from organic wastes on farms and plantations by a judicious application of the fundamental principles underlying their aerobic decomposition. Such humic composts will naturally contain some plant nutrients, which should be conserved so far as is compatible with a high yield of humified material, which it is the prime function of composts to supply.

Table 1. Yield of green fodder (total of three cuttings). Lucerne.

| Yield | Well-rotted dung manure ($N = 0·371$ per cent; $P_2O_5 = 0·69$ per cent). Carts per acre 10 | 20 | 30 | Municipal compost ($N = 0·44$ per cent; $P_2O_5 = 1·27$ per cent). Carts per acre 10 | 20 | 30 | Well-rotted dung manure (10 carts/acre) Super (762 lb./acre). |
|---|---|---|---|---|---|---|---|
| Mds. per acre | 387 | 411 | 429 | 351 | 405 | 470 | 429 |

$P < 0·05$; significant difference 73.

Under certain conditions crops may respond to nutrients contained in composts equally well or better than to those in inorganic fertilisers (Table 1). Under other conditions it may be otherwise, but it seems that for the most efficient utilisation of added inorganic nutrients a certain level of soil organic matter content—which may or may not be found in a given soil—is necessary for each crop. This is illustrated by the following pot-culture results on cotton. Such pot-culture results have been confirmed by field trials on several crops.

Table 2. Yield of seed cotton (gm. per plant). Pot culture experiment 1934–35.

| Nutrients | Cambodia (Indore 1) No treatment | Cambodia (Indore 1) Compost | Malvi 9 No treatment | Malvi 9 Compost |
|---|---|---|---|---|
| Nil | 3·5 | 4·9 | 2·8 | 6·3 |
| N | 4·8 | 14·0 | 3·2 | 13·9 |
| P | 10·7 | 6·8 | 2·7 | 6·3 |
| K | 7·7 | 19·2 | 2·3 | 9·9 |
| N, P | 15·6 | 18·7 | 15·2 | 12·7 |
| N, K | 8·6 | 13·7 | 3·9 | 13·4 |

$P < 0·01$; significant difference = 2·4.
Rates of manures used per kilogram of soil.
Compost: to supply 200 mgm. of N.
N, K, P: „ „ of each.

Hence, in our view, humic composts do not necessarily compete with inorganic fertilisers; rather they are complementary to each other.

Y. D. WAD.
F. K. JACKSON.

Institute of Plant Industry,
Indore, India.
Feb. 12.

## The Nature of Light

SIR J. J. THOMSON[1] has suggested that a photon is a finite, harmonic train of circular lines of electric force originating when an electron in a radiating atom falls from one energy-level to another. Such circular lines of force would move at right angles to their planes, and their centres would travel along a straight line with the velocity of light. If a set of electromagnetic waves of the kind suggested could exist, the energy in any wave-front could be concentrated around the axis of propagation, so that the radiation could be confined within a cylindrical pencil and would not be dissipated through space. The 'photon' would therefore travel unchanged without loss of energy.

It seems to be quite impossible, however, that the solutions of Maxwell's equations propounded by Thomson can exist in any reasonable medium.

The electric intensity of the circular lines of force obeys an expression of the form $Q = A\rho + B/\rho$, where $A$ and $B$ are constants and $\rho$ is the usual radius vector of cylindrical co-ordinates. To satisfy conditions of finiteness, there must exist an unpleasantly arbitrary value of $\rho$ $(= a)$, such that $B = 0$ when $\rho < a$ and $A = 0$ when $\rho > a$. Outside this 'core' of radius $a$, the magnetic vector, $\gamma$, parallel to the axis of propagation, vanishes, and there is no radial flow of energy. Inside the 'core', however, $\gamma$ is finite and constant, and there is a radial flow of energy, which, presumably, would have to be dissipated at the mathematical surface, $\rho = a$. This difficulty, of course, is to be traced back to the fact that, although Thomson has made the tangential electric vector continuous in crossing the arbitrary interface, he has not satisfied the continuity condition for the tangential magnetic vector at the same boundary. This last condition can be complied with only if $A = 0$. As a consequence, $Q$ can be finite everywhere only if it vanishes everywhere.

Such cylindrical wave-trains can exist therefore only if, imbedded in the propagating medium, there is a perfectly conducting surface at $\rho = a$.

C. HURST.

Jesus College,
Oxford.
Feb. 14.

[1] NATURE, **137**, 232 (Feb. 8, 1936).

### Effect of Lunar Eclipse on the Ionosphere

FOR some time we have been studying the variation of height of the different layers of the ionosphere at different hours of the day and night by the well-known group-retardation method. The technique of Breit and Tuve[1], with the later improvements suggested by Appleton and Builder[2], has been adopted for emitting short radio pulses from an aerial system of half-wave Hertzian horizontal dipole type, fed by a Lecher system. The receiver with the recording system of cathode ray oscillograph is located at a distance of about 1·5 km. from the transmitter. It may be mentioned that the average equivalent height of the Kennelly-Heaviside, or *E* layer, is found to be 100 km., and that of the Appleton, or *F* layer, about 270 km. The observations have been taken with waves having frequency of 3·8 megacycles per second.

During the lunar eclipse of January 8, 1936, a whole-night observation showed that the echoes from the *F* layer, which were prominent before the eclipse, became substantially feeble during the totality between the hours 2330 and 2354 I.S.T. The reflected waves regained their former strength after the eclipse. This observation indicates that the moon has also some contributory effect in changing the ionisation of the upper atmosphere. The ion-content becomes appreciably minimised during the absence of the moon. This presumably may be due to the presence of ultra-violet waves which appear in the lunar spectrum[3].

S. S. BANERJEE.
B. N. SINGH.

Physics Laboratory,
Benares Hindu University,
Benares, India.
Jan. 27.

[1] Breit and Tuve, *Phys. Rev.*, **28**, 554 (1926).
[2] Appleton and Builder, NATURE, **127**, 970 (June 27, 1931).
[3] Hanson and Hulburt, *Phys. Rev.*, **37**, 477 (1931).

## Points from Foregoing Letters

THE results of research on the carbon dioxide content of air under various conditions, carried out immediately prior to his death by Prof. J. S. Haldane, together with Dr. R. H. Makgill, are outlined by Prof. J. B. S. Haldane. The influence of height above ground, vegetation, seasons, soil, sea, city surroundings, etc., is indicated. The simplicity and rapidity of the method devised may render it useful in other fields, for example, for distinguishing, in meteorological observations, between bodies of air of different origin.

Dr. Albert Fischer finds that by transferring a few drops of a solution (*A*) of serum globulin (at 70° C.), in process of coagulation, to a fresh solution (*B*) of the same substance, the rate of induced coagulation in (*B*) depends upon the rate in (*A*) at the moment of transfer. From the retarding effect of alkali, he infers that such chain reactions, leading to the denaturation of proteins, may be explained by the appearance of radicals ($-NH_2$, $-SH$) on the surface of the spherical protein molecules.

Diagrams showing the atomic arrangements in crystalline powders of prussian blue and related pigments, as deduced from X-ray investigations, are submitted by J. F. Keggin and F. D. Miles.

Absorption of light by several of the compounds of hæmoglobin (red pigment of the blood) has been investigated by G. A. Adams. These substances show a common absorption point in the region of 4100 A., which is apparently due to the porphyrin ring system in 'hæm' (a basic compound the hydrochloride of which is hæmin, a bluish-black decomposition product of hæmoglobin).

By using Geiger-Müller counters (for counting ionising particles) with walls made of nickel and of tin, and irradiating them with slow neutrons, R. Naidu finds that induced radioactive substances are produced. In the case of nickel, the half-life is three hours, while in the case of tin two half-periods of 8 and 18 minutes respectively are observed.

The secondary emission of molybdenum with various amounts of barium surface contamination has been studied by L. R. G. Treloar. A definite relation has been established between secondary emission and work function, provided that the contamination is not more than one atom thick.

A new possible way in which electrons can escape from the cathode of an arc is indicated by Dr. M. J. Druyvesteyn; if the cathode is covered with a very thin layer of an insulating substance, the number of positive ions on its surface can produce a high field which will enable electrons to escape from the metal, and penetrate through this insulator into the gas with a high velocity, without recombining with the ions on the surface.

According to Drs. I. Ramakrishna Rao and C. Sambasiva Rao, a study of the Raman effect in strong electrolytes suggests that, while all molecules with electrovalent bonds are completely dissociated even in highly concentrated solutions, those with covalent bonds (possible only between the anion and the hydrogen ion) change progressively with dilution into the electrovalent type and thus towards complete dissociation.

John F. Marshall and J. Staley report observations on the mosquito *Theobaldia subochrea* which indicate that this species possesses the rare characteristics of mating within small cages and laying fertile eggs without a previous meal of blood.

A case of transference of the mite, *Tarsonemus pallidus*, from cyclamen to a strawberry plant is reported by D. O. Boyd and W. E. H. Hodson.

The existence in the fat-soluble extract of kale or alfalfa of a new vitamin the absence of which leads to gizzard erosion in chicks, is indicated by experiments reported by H. J. Almquist and E. L. R. Stokstad. The authors show that the needed dietary factor is distinct from that responsible for the prevention of hæmorrhage in chicks.

Y. D. Wad and F. K. Jackson of the Institute of Plant Industry, Indore, show that humic composts and inorganic fertilisers should be regarded as complementary to each other and not necessarily competing. For the most efficient use of inorganic nutrients, soil organic matter must be in proper condition and must reach a certain level. If the necessary amount, which varies with the crop, is not present, humic composts may be employed to adjust the level.

# Research Items

## Origin of Iron in Antiquity

IN *Antiquity* for March under the title "The Coming of Iron", Mr. G. A. Wainwright reviews in some detail the recorded finds of early examples of iron, and on this evidence offers suggestions as to the source of this metal in antiquity. The most ancient pieces of iron known are the beads from Gerzah, some fifty miles south of Cairo, which were found by himself. These are dated at about 3500 B.C. Sir Leonard Woolley found some fragments of iron in the Royal Tombs at Ur, which are dated at 3000 B.C. but may possibly be so early as 3500 B.C. These two specimens of early iron contain 7·5 per cent and 10·9 per cent of nickel respectively and are, therefore, meteoric. All early iron was formerly held to be meteoric; but Desch's analysis of the fragment with a bronze dagger handle found by Frankfort at Tel Asmar in Mesopotamia showed that smelted iron was in use in 2800 B.C. The celestial origin of the rarely occurring iron in early Egypt is recognised by the addition of the epithet "from the sky" added after the fourteenth century B.C., when smelted iron had been introduced. Egypt actually was the last of the countries of the East to receive iron, and then only under the intensification of influences from the north. In Mesopotamia iron was as rare as in Egypt until 1100 B.C. In Asia Minor from the twentieth century onward iron was used regularly, and from the fifteenth century Asia Minor, northern Syria and north-west Mesopotamia exported iron objects; while it was clearly the wanderings of the Asianic tribes which brought iron to Palestine in the fourteenth and thirteenth centuries. By 1100 B.C. Assyria, Carchemish, Cyprus, Greece and the Ægean were entering the iron age; while in the eighth century Sargon had in store one hundred and fifty tons of iron, of which the ingots resemble in their curious shape those which two hundred years later were entering Germany and France with the La Tène culture.

## Development of the Kidney in the Frog

ALTHOUGH much work has been carried out on the development of the urino-genital system of *Rana*, the story was incomplete in certain respects and in particular in regard to the post-metamorphic changes in the male. Those of the female are clearer since there is not the same close anatomical connexion between the urinary and genital ducts. P. Gray (*Quart. J. Micro. Sci.*, 78, Pt. III; 1936) has filled in this gap and helped to disperse some of the previous misconceptions. Part of the confusion that exists in earlier accounts is due to the failure to recognise that in the adult three different regions are represented in the kidney. At metamorphosis, only the anterior and middle regions are present, and these are characterised *inter alia* by the possession of straight tubes running transversely. The first one or two of these are concerned with the passage of sperms, the next three or four carry both sperms and excretory products. Behind these are about six tubes, originally straight but afterwards becoming bent, which only serve to carry urine. In the posterior region, which begins to differentiate at the beginning of the second year, there are no straight tubes and it has no genital function. Kidney and genital ridge are connected by a sheet of blastema. This sheet breaks up into a number of strands, the rudiments of the vasa efferentia. In the second year the vasa run from the kidney, within which they are connected with a strand of blastema representing Bidder's canal, to the testis. The seminal vesicles are developed from a group of from four to six clumps of kidney blastema cells near the posterior end of the archinephric duct. It is not until the third year that these develop into the coiled tubes characteristic of the adult. The author suggests that they may represent the remains of an ancestral kidney specialised for sperm storage.

## The European Corn Borer in North America

THIS insect is the larva of the moth *Pyrausta nubilialis* which was first discovered in the United States in 1917. It most probably was accidentally imported with broom-corn from Hungary or Italy, and had already been in the United States for some years before being detected. The results of sixteen years' investigation have shown that it is one of the most injurious plant pests that have invaded that country. According to the account given by Mr. D. J. Caffrey in the U.S. Farmers' Bulletin, No. 1548 (revised August 1935), a total area of about 265,000 square miles were infested by this pest at the end of 1934, while it has also invaded a large area in eastern Canada. So far, it does not appear to have extended farther west than the great lakes, while its eastward range reaches to New England and Long Island, N.Y. While corn (maize) is its chief host, it also attacks various wild and cultivated plants. Control by biological means is a scheme the possibilities of which are being fully explored: some millions of parasites from Europe and the Orient have been liberated and certain of these are now established over limited areas. Whether biological control will prove effective to an economic degree is uncertain, and several years, at least, must elapse before any judgment can be formed. Control by cultural methods is, however, effective and can be achieved by utilising or destroying all parts of infested plants each year before the insects develop from the borer stage into the moths.

## Anomura of the Dutch East Indies

DR. I. GORDON has described the Anomura (excluding Paguridea) from the Dutch East Indies (Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique.* Hors Séries. 3, fascicule 17, 1935). There are only a few of these, and all belong to known species of *Galathea*, *Petrolisthes*, *Pachycheles*, *Porcellana*, *Polyonyx* and *Remipes*. It is, however, a satisfaction to have further records of little-known forms which usually differ slightly from the original descriptions, notably *Galathea affinis consobrina*, de Man, which has peculiar feathered setæ on the dorsal surface of rostrum and eye-stalks, not present in the type specimens. The paper is illustrated with clear text figures.

### Apple Rootstock Studies

A FURTHER stage has been reached in the intensive survey of apple rootstocks initiated by R. G. Hatton at the East Malling Research Station sixteen years ago. The apples then planted showed early indications of differential influence of stocks on the vigour of the scions, and subsequent reports showed the possibility of grouping the stocks according as their influence was relatively dwarfing or invigorating. The latest report (*J. Pom. and Hort. Sci.*, 13, 4, 293; 1935) shows that whilst certain rearrangements in the order of stock influence have occurred since the 1928 records were published, the main result is an accentuation of the original differences. The several criteria of vigour adopted, namely, total wood growth, thickness of trunk, height and spread of branches, and total weight of tree, give substantially similar results. Stocks *M*IX and *M*XII are consistently the most dwarfing and most vigorous respectively, and certain stocks of intermediate vigour give the same relative order with different scions. Data obtained by other workers at East Malling have shown that the ratio by weight of tops to roots remains constant for a scion on different stocks, though the actual weights vary. A review of the work of other investigators indicates that storage qualities and chemical composition of fruits may be influenced by rootstock, but resistance to certain diseases does not seem to be transmitted from stock to scion. Hatton attaches but little significance to the influence of scion on stock, but this aspect of the problem is not without importance, and much work remains to be done before the obscure relationship between these two parts of an apple tree is thoroughly understood.

### Trachyte and Olivine-Basalt Associations

A CONTRIBUTION to petrogenesis of considerable interest is made by A. B. Edwards in the course of an investigation of the association of trachyte with olivine-basalt in the Tertiary igneous provinces of Victoria, Kerguelen Island, and Otago, New Zealand (*Proc. Roy. Soc. Victoria*, 48, 13; 1935). It is concluded that the association in these three areas supports the hypothesis that alkaline rocks are the normal product of differentiation of an olivine-basaltic magma, so long as there is no undue contamination by contemporary syntexis. The factors controlling differentiation are summarised as (*a*) chemical composition of the primary magma, acting through the type of pyroxene that crystallises; (*b*) the growth of cupola-like extensions above the main reservoir, permitting the accumulation of alkaline magma in localised bodies; and (*c*) the oxidising conditions ushered in by gas-streaming during extrusion, and the transport of sodic material accomplished by such streaming. In the absence of an immediately antecedent orogeny, such alkaline rocks can develop in a continental sialic region as readily as in an oceanic region; but conditions attending orogenesis favour large-scale assimilation of argillaceous and siliceous sediments, with accompanying production of andesitic types.

### Canadian Earthquake of November 1, 1935

WE have received from Mr. E. A. Hodgson of the Ottawa Observatory a copy of his preliminary report on this important earthquake. From the records obtained at seven neighbouring stations, the epicentre is temporarily placed in lat. 46° 47′ N., long. 79° 4′ W., or about four miles north-north-east of Timiskaming, Que., and the focus is believed to be at a depth of about 125 miles. One result of this great depth is the large area of more than 500,000 square miles over which the shock was felt. Soon after the earthquake, Mr. Hodgson spent a month in the district around the epicentre. No fissures in bed rock were detected at any point; but it was found that the rails on the line from Kipawa to Dozois had shifted between points a few miles to the east and north of the epicentre.

### Vision

THE review of recent progress in our knowledge of the underlying processes of vision which Dr. R. Granit of the University of Helsingfors contributed to vol. 76 of the *Finska Läkaresällskapets Handlingar* has now been made available to a wider circle by appearing in German in vol. 14 of *Acta Ophtalmologica* (Copenhagen: Levin und Munksgaard, 1936). In his review he insists on the importance of considering visual processes as a part of the physiology of the central nervous system. At points of the optical system where two or more paths for the impulse converge, interaction is possible, which may lead to summation or inhibition. He believes that future progress will be based on the duplication theory, according to which for small intensities of light the rods of the retina are the receivers and at high intensities the cones. He points out the fertility of the flicker method of illumination for investigating the properties of the retina and gives the results of observations, many of which he has carried out himself, on the frequency of the intermittent illumination at which the sensation becomes one of continuous light. He finds that this frequency increases with the logarithm of the intensity of the light, and with the logarithm of the area of the retina over which it is spread.

### Theory of the Geometric Object

THIS was the title of a lecture given by Prof. J. A. Schouten, of Delft, at King's College, London, on March 17. The idea of a 'geometric object' was first introduced by Klein in 1909. Since the discovery of pseudo-parallelism in 1917, several definitions have been given by Veblen, Whitehead, Schouten and others, but none of these definitions was quite satisfactory. Since the Moscow Congress on Vector and Tensor Analysis in 1934, Wundheiler, together with Schouten and Van Dantzig, have carried on a further investigation of this problem. They have discovered that the lack of rigour in the old definitions was due to the fact that no account had been taken of the two aspects of a geometric object, the functional and the componental. Corresponding to these two points of view they have introduced the following definitions: (1) A *macrogeometric* object is one whose transformed 'determining functions' are functionals of the old determining functions and of the transformation functions. (2) A *microgeometric* object is one whose transformed components are functionals of the old components *at the same point*, and the transformation functions. Every microgeometric object is macrogeometric, but the converse does not hold. By taking a one-dimensional space and the affine group of transformations, an example has been constructed of a macrogeometric object which is not microgeometric. Such objects, however, scarcely ever occur, since objects occurring in geometry are nearly always of a distinct finite class, as defined by Veblen and Whitehead, and when this is the case, the objects can be easily 'completed' into microgeometric objects.

# Phase Variation in Grasshoppers

THE family Acridiidæ includes the so-called 'short-horned' grasshoppers and locusts. Locusts are, in fact, grasshoppers showing special behaviour: they differ from other members of their family on account of their habit, under suitable ecological conditions, of becoming predominantly gregarious, and migrating considerable distances in large swarms.

In 1921, B. P. Uvarov formulated the theory that locusts occur in two forms or phases, hitherto regarded as separate species. In one phase, namely, solitaria, these insects do not differ in behaviour from other short-horned grasshoppers. In the other phase—gregaria—they become gregarious and swarm. In this phase their nymphal coloration is very different from that of the solitary phase and when they become adult, difference in form and the proportional growth of parts reveal themselves. Uvarov's theory was confirmed experimentally by Faure in 1932 and later by others. It has been generally believed that the existence of such phases is a peculiarity of locusts alone. Quite recently, however, I. A. Rubtzov* has shown that an essentially similar phenomenon also occurs in non-swarming short-horned grasshoppers, but that the amplitude of such phase differences is less pronounced than in locusts. Rubtzov's observations were carried out in Siberia and embodied in a paper written in the Russian language. Biologists are indebted to Uvarov for translating this paper and assisting in its publication.

Rubtzov was impressed by the colour variations found in a number of species of grasshoppers. They were found to differ in coloration more or less in accordance with the population density per unit area of territory. Individuals collected from relatively dense associations, with up to 300 grasshoppers per square metre, were notably dark-coloured, larger and had longer wings than those distributed in the proportion of one, or fewer, over the same unit area. These differences are especially marked in *Aeropus sibiricus* and *Chorthippus albomarginatus*, while a number of other species can be arranged in descending order of their tendency to show marked colour differences. The most pronounced differences are found in *A. sibiricus*, which is an active species tending to form dense aggregations of individuals. These differences are almost equally well shown in *C. albomarginatus*. In all cases, the dark-coloured forms occurring collectively are interpreted as representing the phase gregaria, while the pale examples found singly and sparsely are regarded as representing the solitaria phase. This conclusion is supported by such experimental evidence as is available.

Thus, individuals of *C. albomarginatus*, reared in isolation, showed a tendency to develop into the pale-coloured solitaria form, while those reared gregariously, in crowded conditions, produced a very definite gregaria type. Apart from the colour differences alluded to, the supposed phase differences are also betrayed in: (1) solitaria individuals being smaller, with femur and tegmen shorter; (2) shortening of the tegmen in solitaria being more pronounced than that of the femora, the ratio being greater in solitaria than gregaria; and (3) variability in solitaria being always greater than in gregaria—as can be seen by comparing the maximum and minimum figures. Rubtzov's data are accompanied by coloured figures portraying supposed phase differences and they unmistakably suggest that we have, among non-swarming grasshoppers, clear evidence of the existence of those same phases that feature so markedly in the economy of locusts.

A further phenomenon, discussed by Rubtzov, can only be very briefly alluded to here. He shows that a homologous series of colour variations reveal themselves through many species of Acridiidæ. These are inheritable variations and, according to him, each such race possesses the potentiality, to a greater or lesser degree, to exhibit phase characteristics. The latter, as it were, are super-added to the former in response to the extreme conditions of individual life. In practice, it resolves into the necessity, fully recognised by this author, of clearly determining which race of a given species is being utilised in all studies designed to explore the phase idea.

A. D. IMMS.

* Rubtzov, "Phase Variation in Non-Swarming Grasshoppers", *Bull. Entomol. Res.*, **26**, Pt. 4, 499–520 (Dec. 1935).

# Underground Water Supplies

THE Cantor Lectures of the Royal Society of Arts, delivered last winter by Dr. Bernard Smith, director of the Geological Survey of Great Britain, dealt with the "Geological Aspects of Underground Water Supplies". The lectures, which give a comprehensive review of the geological conditions affecting water supplies from underground sources, are now available. In his first lecture, Dr. Smith alluded to the universality of underground water, though, in some cases, it might lie at depths too great to be of practical value, and stated that most of it, in Great Britain, is rain water, which has made its way down from the surface, though a residual quantity of 'fossil' or 'connate' water may have been held in the rocks for great periods of time. Rainfall disappears from the surface of the ground chiefly by run-off, and secondarily by percolation, evaporation and absorption by vegetation, the relative proportions at any given locality depending upon the topography, the degree of rainfall, the porosity of the soil or rock, the amount of water in the soil at the time, the amount of vegetation and the humidity of the atmosphere.

While run-off constitutes surface waters (rivers, lakes, etc.), it should be recognised that much of what is measured as run-off is actually a steady

contribution to the streams and rivers by means of springs and seepages from the underground stores built up by percolation, and it was emphasised that in cases during the past drought where reservoirs or lakes utilised for public supply were maintained at a fair level, this was owing entirely to underground water which issued steadily as feeders for the impounded supply. The relative proportions of evaporation, run-off and percolation vary greatly in different localities and seasons, so that general formulæ applicable to any district cannot be used with safety. Evaporation may be 50 per cent of the rainfall; run-off up to 92 per cent and percolation 80 per cent or even 90–95 per cent.

The properties of rocks in regard to absorption and transmission of water were discussed by Dr. Smith, who pointed out the distinction between porosity and perviousness, stating in regard to the former that 30–40 per cent of the volume of a mass of loose sand and gravel is represented by pore-space, whilst that of naturally cemented sands and gravels is only half that amount. On the average, igneous rocks have a pore space of 1 per cent, shale has 4 per cent and limestones have an average of about 5 per cent. On the other hand, the porosity of chalk attains a maximum of about 50 per cent. Pore spaces vary in size from the microscopic (micropores) to those visible to the naked eye (macropores), and the relative proportions of these to the total porosity of a rock determine to a large extent its perviousness (apart from fissures).

The perviousness of a rock is its capacity to allow water to pass through it, and depends not entirely upon the porosity (total volume of pore space), but rather on the size of the pore spaces and their continuity or interconnexion one with another. In most districts, the rocks are saturated below a depth dependent upon several factors—porosity, amount of rainfall and surface profile. In permeable rock, the surface of the saturated zone is termed the 'water table' and the water below it 'ground water'. Above the water table, in the sometimes-called 'zone of aeration', is 'wandering' or 'vadose' water. Water tables are fairly easy to determine in the comparatively unaltered stratified rocks, but not so easy in the impervious, or relatively impervious rocks, exemplified by the more ancient strata and by igneous rocks.

While in granitic areas large supplies are best sought from streams, yet many smaller supplies are to be found underground, due to the water held in the joints. This is particularly the case in Cornwall and Devon. As a class, however, granitic and kindred rocks are not good aquifers, and, in his second lecture, Dr. Smith discussed the Upper Palæozoic, Mesozoic and Tertiary strata, in which underground water occurs in large quantities. The fluctuation of the water table and the breaking out of bournes were described, with instances in the chalk uplands and elsewhere, and reference was made to the researches of Baldwin Latham and others.

Artesian wells and basins received explanatory notice, and it was pointed out that some artesian wells are very deep, having been bored to 4,000 ft. in Berlin and in St. Louis and Pittsburgh. These are deeper than any in Great Britain, most of which range at various depths up to 1,000 ft., with specially deep cases at Ottershaw (1,585 ft.), Virginia Water (1,430 ft.) and Boultham, Lincoln (1,562 ft.). The exhaustion of artesian wells may be brought about by over-pumping of the natural reservoir, clogging of the rock pores, unsatisfactory casing and heavy pumping from neighbouring wells. Of the pervious, or partly pervious, formations of Great Britain, the Carboniferous, Millstone Grit and Coal Measures; the Triassic sandstones, the Inferior and Great Oolites, the Lower and Upper Greensands and the Chalk may be regarded as the chief water-bearing strata.

In the final lecture, the geological complications (faults, flexures, cover) affecting the circulation of underground water were considered, the variation in thickness of strata and missing formations. The best way of studying the question of thickness is to draw 'isopachytes' or 'lines of equal thickness'. This information, together with surface contours related to Ordnance datum, should prove of great utility. Another point of interest to hydro-geologists and water engineers is the change in the quality of water beneath cover, from that of water at the outcrop. Most waters, where traced down an artesian slope, or into an artesian basin, are found to change in mineral character, sometimes quite rapidly.

Dr. Smith concluded his review by remarking that the question of locating supplies is often a complex matter, demanding considerable knowledge from the hydro-geologist and skill from the water engineer.

# Recent Developments in Luminous Discharge Tubes

IN the *Electrician* of January 31, Mr. C. C. Paterson gives an interesting account of recent developments in luminous discharge tubes. There are two directions in which developments are making rapid progress. The first is the use of 'super pressure' lamps, and the second is the use of luminescent powders.

The high-pressure mercury vapour lamp which runs at a pressure of 150 atmospheres is a very courageous step in advance, but it is not yet known whether it will prove suitable for practical use. In the ordinary mercury vapour lamp, the vapour is under a pressure of two atmospheres; the luminous column does not fill the tube, but contracts into a 'rope' stretched along its axis, and most of the power is being expended inside this. As the vapour pressure increases, the total volume of the luminous vapour diminishes, and as the power is concentrated in this, the ionisation becomes extremely intense and the intrinsic brilliancy greatly increases.

The possibility of the usefulness of luminescent powders has now been demonstrated in the case of cold cathode (high voltage) tubes, and doubtless they will soon be applied to hot cathode tubes. Luminescent powders have been used for some years, but research has now shown methods of greatly enhancing their brilliancy. Mercury vapour has marked radiation in the ultra-violet, and when it falls on a suitable luminescent material its wave-length becomes longer and the radiation becomes visible. Zinc and cadmium sulphides are well known to be luminescent, but there

are many other substances, and so research in this direction is most promising.

Mr. Paterson has experimented with a 'sign type' tube which without luminescent powder gave 20 candles (250 lumens) with an efficiency of about four tenths of a candle per watt. With the inside surface coated with one of the new powders and using the same electric power, it gave 240 candles, the efficiency being increased twelve times.

One of the attractive features of luminescent powders is the 'band' nature of their spectra. As a rule, ordinary luminous discharge tubes emit line spectra at a definite number of single and isolated wave-lengths; the powders under suitable stimulation emit over a group of wave-lengths. They are thus very suitable for filling in gaps in the spectra of the light given out by vapours and gases.

Another type of lamp developed last year uses a tungsten filament in series with, and in the same transparent envelope as, a high-pressure mercury discharge tube. This serves the double purpose eliminating part of the regulating device and introducing much needed red radiation into the light coming from the mercury vapour. The efficiency is of the order of two candles per watt, and the combination will be a competitor to the tungsten lamp for the interior lighting of factories.

# Electrically Produced Music

THE paper read before the Royal Society of Arts on March 4 by Mr. G. G. Blake on electrically produced music considered only those instruments which depend on the method known in radio as the 'heterodyne'. Mr. Blake showed first the production of beat notes by two musical instruments. When they were both vibrating at the same frequency they emitted the same note. By gradually altering the frequency of one of the instruments, a third—the heterodyne—note could be heard. As the instruments went more out of tune, the frequency of the beat note became higher. This showed the heterodyning of sound waves.

When radio waves produce a heterodyne note at very high frequencies, each of the individual notes is inaudible, but the beat note takes place just as with low-frequency sound waves and is clearly audible. Mr. Blake, using a special instrument which he calls the ethonium, showed the following phenomena. The instrument consisted merely of two electrical transmitters suitably coupled to a wireless set. With the two transmitters and the wireless set in tune, nothing could be heard. When one of the transmitters was slightly detuned, beat notes were emitted from the loud speaker of the set. Movement of the hand towards or away from the aerial attached to one of the transmitters varied the frequency of that transmitter and the musical notes produced varied from deep bass to the shrillest treble. The alteration of note is due to very minute changes in the electrostatic capacity of the aerial. The slightest movement of the hand at a distance of a yard from the aerial alters the pitch of the note.

The circuits of the ethonium were then readjusted and the existence of a zone about two feet from the aerial was demonstrated where the presence of the hand produced no effect. Moving the hand from this zone to or from the aerial produced a deep bass note, increasing in pitch the farther the hand was moved away from the zero zone. Moving the hand away from the aerial diminishes its capacitance. Mr. Blake showed how the zero zone could be moved farther away from or nearer to the aerial.

In working the instrument, the control of this zero zone is of importance. It gives the player the ability to extend or contract the length of the musical scale over which he intends to play. It can be compared to a piano with an elastic keyboard which can be extended so as to make it suitable for a man with long arms, or contracted to suit a player with a short reach.

A demonstration was given of the superposing of music played by the ethonium upon radio-gramophone music. By connecting the electro-magnetic pick-up from a gramophone to the grid circuit of the first amplifying valve of the wireless set, the amplifier also being connected to the detector circuits, a musician can play any music he desires on the ethonium, to a suitable radio-gramophone accompaniment, his music and that of the gramophone being produced simultaneously from the loud speaker of the wireless set.

It has been shown previously by Theremin and others that unwanted harmonics can be easily suppressed by suitable filter circuits and needful overtones can be introduced. Thus the quality of electrically produced music can be altered so that it gives a faithful imitation of a flute, a violin, a cornet, a banjo and other musical instruments.

An important fact demonstrated by Mr. Blake was that the production of musical notes by heterodyne is independent of the fundamental frequency of the transmitters employed. Provided the two transmitters are exactly in phase initially, they can be operated at any desired frequency. One of the ethoniums shown operated at 1·25 million cycles. When one of its transmitters is detuned it is only oscillating at 1·2499 million cycles, the difference of frequency between the transmitters being 100 cycles, which is within the audible range. Another of the ethoniums shown operated at a frequency of 0·67 million cycles; if one of the transmitters be detuned to a frequency of 0·669,900 the difference between them will be again 100 cycles, and the second ethonium emits exactly the same note as the first. When both the ethoniums sound simultaneously, no wireless interference takes place between them. This opens up the possibility of electrically produced orchestral music from a number of these or similar electrical instruments when played simultaneously.

Many instructive lecture experiments were shown. With the ethonium tuned to silence, it was demonstrated that almost any object placed on the top of the aerial increased its capacitance so that it produced a note. The notes produced by a pin, a coin, a lump of sugar, an onion, etc., were easily heard and distinguished. Placing a piece of cardboard, a sheet of glass, a large suitcase, a wooden drawing-board or a metal tea-tray between the hand of the player and the aerial did not interfere with the use of the instrument; but when the object was metallic, it was essential that it be insulated from the earth.

## Clocks in the Paris Observatory

THE *Bulletin Horaire du Bureau International de l'heure* of February gives an account of the running of the clocks at the Paris Observatory during 1935.

It is interesting to note that a British clock, the Shortt free pendulum No. 44, has given the best performance of the year, and indeed this particular clock has put up a year's performance which is probably unequalled by other clocks of the same make. During 1935, the monthly mean values of the daily rate varied only from $-0\cdot367^s$ per day to $-0\cdot377^s$ per day, and the accidental variation of the daily rate from the mean value for the month was only $0\cdot0017^s$. In computing the last figure, the Paris astronomers took account of the variation in apparent clock-rate due to long period nutation, the principal term as regards clock-rate in which has an amplitude of $\pm0\cdot003^s$ per day and a period of six months. It has hitherto been considered in Paris unnecessary to take this term into account in discussing clock-rates.

The best Shortt clock at Greenwich is No. 3, which has twice given a straight run, so far as could be determined, over a period of three months, that is to say, that during the three months the clock error was not observed to depart from the value corresponding to the mean rate. A clock error greater than $0\cdot01^s$ should be detected. It has been habitual to take account of both long and short period nutation at Greenwich in discussing clock performances.

To clear up misunderstandings about this subject, it is as well to state here that wireless time signals are sent out on mean time, which is unaffected by either long- or short-period nutation. The sidereal time contains nutation, so that the error and rate of a mechanically perfect clock show the nutation when compared with true sidereal time. In discussing the mechanical performance of the clock, it is ideally necessary to remove nutation from the sidereal time, which is what one determines by transit observations. The corrections for nutation have always been made in computing mean time for wireless signals from transit observations, but in discussing sidereal clock rates, determined from transit observations, long-period nutation has sometimes been ignored, as its effect on the rate (but not on the error) is small.

## Educational Topics and Events

CAMBRIDGE.—The following grants towards the expenses of expeditions have been made from the Worts Fund: £50 to F. E. Kemp, an expedition to the Great Barrier Reef; £50 to N. E. Odell, to study glacier movements in the Eastern Himalayas; £30 to T. T. Steiger, to study the effects of European civilisation upon the life of a native tribe in Uganda; £40 to G. E. Daniel, for archæological purposes in the Western Mediterranean; £37 to J. S. Turner, for an ecological survey of the oak woods of the Killarney region; £40 to Miss C. K. Rickardo, to study the ecology of a small lake in Rhodesia; £50 to M. G. M. Pryor, to study the ecology and distribution of the Trichoptera (caddis flies) of the mountains of northern Jugoslavia.

The General Board recommends that the following additional University teaching offices be established from October 1, 1936: a readership in the Department of Geology, a University demonstratorship in soil science in the Department of Agriculture, a University demonstratorship in the Department of Botany (subject to the requirement that the person appointed shall act as curator of the Herbarium and the Botanical Museum), a University lectureship in the Department of Zoology, a University demonstratorship in the Department of Zoology (subject to the requirement that the person appointed shall act as senior curator of the Museum of Zoology), a University lectureship in the Department of Physiology (temporarily replacing a demonstratorship).

At Downing College, Dr. J. Hammond has been elected to a non-stipendiary fellowship.

LONDON.—Prof. J. G. Semple has been appointed as from October 1, 1936, to the University chair of mathematics tenable at King's College. Since 1930 he has been professor of mathematics in the Queen's University, Belfast.

The title of reader in electrical engineering in the University has been conferred on Mr. W. J. John, in respect of the post held by him at Queen Mary College.

It has been resolved that, on the occasion of the centenary celebrations of the University this year, degrees should be conferred *honoris causa* on thirteen British and six foreign distinguished men, including Sir William Bragg, Mr. S. A. Courtauld, Sir Joseph Larmor, Dr. J. W. Mackail, Sir George Newman, Sir Charles Peers and Mr. H. G. Wells; and Prof. Albert Einstein, Prof. Johan Hjort and Prof. Max Planck.

The following doctorates have been conferred:—D.Litt. on Mr. C. E. M. Joad, of Birkbeck College; D.Sc. in chemistry on Mr. F. D. Miles, of the Imperial College (Royal College of Science); D.Sc. in engineering on Mr. S. J. Davies, University reader at King's College.

Dr. C. D. Ellis has been appointed as from October 1 to the Wheatstone chair of physics tenable at King's College. Since 1923 he has been lecturer in natural science at Trinity College and lecturer in the Department of Physics in the University of Cambridge.

The London (Royal Free Hospital) School of Medicine for Women has received an anonymous gift of £11,000 to endow "The Free Woman's Lectureship in Clinical Medicine". Dr. Una Ledingham, assistant physician, Royal Free Hospital, has been appointed to the lectureship. The Aldrich Blake travelling scholarship (1936) has been awarded to Miss Geraldine Barry, assistant surgeon, Royal Free Hospital.

DR. J. M. GULLAND has been appointed to the Sir Jesse Boot chair of chemistry in University College, Nottingham, in succession to Prof. F. S. Kipping, who is to retire at the end of the session. Dr. Gulland is at present reader in biochemistry, University of London, and senior assistant in biochemistry in the Lister Institute. Prof. W. H. McMillan, head of the Department of Mining and Fuels of the College, has submitted his resignation on being appointed to the James A. Hood chair of mining in the University of Edinburgh and the Heriot Watt College, Edinburgh. Prof. McMillan was the first occupant of the chair of mining established at Nottingham in 1911.

## Science News a Century Ago

### The Entomological Society

AT a meeting of the Entomological Society held on April 4, 1836, the Barons Ooskay de Oosko, and De Chaudoir, M. Fahraens, Governor of the Province of Gottenburg, and several other distinguished entomologists were balloted for and elected foreign members of the Society.

### The Horticultural Society

AN exhibition by the members of the Horticultural Society was held on April 5, 1836. This exhibition, said the *Athenæum*, was of much greater interest than recent displays, "and though late in the season for Camellias, was very rich in specimens of that beautiful tribe, it being understood that medals would be bestowed for the best Chinese varieties and English seedlings. Those plants that were still in bloom therefore in the collections of the most celebrated growers of these plants, were brought into contrast. . . . The Camellias from Mr. Donald's nursery were remarkable on account of their being from the open ground and only slightly protected in the winter; the plants averaging in size from two to four feet in height and from six to nine feet in circumference".

### Louise-Philippe and the French Surgeon Desault

QUOTING from *Galignani's Messenger* on April 6, 1836, *The Times* said: "It is well known that his Majesty Louis Philippe, in his youth, besides the usual studies of his age and rank, applied himself to the acquirement of many of the useful arts and sciences, and, among the rest, to surgery, in which he became the pupil of the celebrated Desault. Being informed that a subscription was being made for raising a monument to the memory of this restorer of surgery in France, in his native town of Lure, in the Upper Saone, he desired the list of subscribers to be brought to him, and inserted his name for the sum of 300 f., writing at the same time the following note:—'Desault was my master and professor in surgery. I assisted him as one of his dressers, and it was he who put the lancet into my hands, causing me to bleed patients at the Hôtel-Dieu of Paris'."

Desault was born on February 6, 1744, became surgeon of the Hôtel-Dieu in 1788 and died on June 1, 1795.

### Progress in Medicine

IN his inaugural address (*Gazette des hôpitaux*, April 7, 1836) at the Hôpital de la Charité, M. Bouillaud, professor of clinical medicine in the Paris Faculty, said it was difficult to understand how some persons could assert that there was no progress in medicine. Every discovery of facts, every theory, doctrine or system was progress, so that to deny the existence of progress was almost as ridiculous as to deny the existence of motion. Physics at the present time was not that of antiquity, the chemistry of Fourcroy was not that of Berzelius, Thenard, etc., nor was modern philosophy that of Socrates or Plato. Physics, chemistry and all the other accessory sciences were indispensable to the physician, for how could the theory of movement, the chemistry of the organs, circulation, etc., be interpreted without a more or less profound knowledge of the laws governing inorganic bodies? The ancients knew nothing of physiology. They did not possess the knowledge of etiology which we have, although Hippocrates had studied the influence of air, waters and places. Treatment, the corollary of pathology, had made undoubted progress, though it was still far from perfection, for it was often irrational and empirical. Without going into further details, percussion, auscultation and mensuration were obvious proofs of the progress of medicine. Men of progress were rare. If one compared the progress of medicine from Hippocrates to Morgagni with that made from Morgagni and Bichat down to the present time, one would realise the immense strides made by medicine in the last century. France was one of the most progressive countries and one in which medicine had not lagged behind the other sciences.

### The Adelaide Street Gallery of Science

IN *The Times* of April 8, 1836, appeared the advertisement: "SPLENDID EXHIBITION. Adelaide Street Gallery.—The Council of this Institution, anticipating numerous visitors at this season, have directed for *Exhibition* the most familiar yet brilliant chymical and other experiments, the Microscope (very frequently repeated), Magnets, Cosmoramas, Steam-Gun, Combustion of Steel, Rope Dancers, Chinese Jugglers, Silk Looms, Printing Press, Minerals, Paintings, Tapestry, Sculpture, Models—Nautical, Mechanical, Architectural, etc. Open from 10 till 6 o'clock. Admission 1*s*. or annual subscription £1."

### Statue of Cuvier

ON April 9, 1836, the *Athenæum* said: "M. David has now finished his second statue of Cuvier. It is in an erect posture and robed in the costume of Counsellor of the University, and is to be placed in the new gallery of Mineralogy at the Jardin du Roi. M. David has aimed at the expression of consummate genius in the head, as he had, in the previous statue for Montbeliard, conveyed the impression of deep thought. The same distinguished sculptor has just executed a colossal bust in marble of the great Berzelius, whose nuptials in Sweden have just been celebrated."

### Epidemic Disease in France

ACCORDING to a note in the *Gazette médicale de Paris* of April 9, 1836, the Royal Society of Medicine of Marseilles was offering a prize of 500 francs for the best essay in French or Latin dealing with the following two questions: Has the recent occurrence of cholera in France sufficiently settled our views as to its mode of propagation as to justify a modification of the existing sanitary legislation? (2) Up to what point have our ideas on the propagation of typhus, yellow fever and plague been modified by the great epidemics in France, and to what extent may the legislation on these diseases be modified? The Society, in accordance with the views held by the great majority of French practitioners, regarded cholera as not contagious. This conviction, however, was not obligatory for candidates, who were free to express their personal opinions on the subject.

## Societies and Academies

### DUBLIN

**Royal Irish Academy**, March 16. STEPHEN SHEA: Observations on the structure of the pulmonary alveolar wall in the adult rat, guinea pig and rabbit. A variation of the method of using acridin red as a stain was employed. Thick benzol colophonium was found to retain the stain in the tissues. It was demonstrated that the tissue separating the blood capillaries from the alveolar air consisted of three distinct layers—and an outer cellular membrane. The cell nuclei of the outer membrane closely embrace the capillaries. Fine prolongations of cytoplasm extend over the alveolar aspect of the capillaries completing the membrane.

### PARIS

**Academy of Sciences**, February 24 (*C.R.*, **202**, 601–704). ALFRED LACROIX: Chemical composition of the lavas of Easter Island. Complete analyses of sixteen rocks, and remarks on the lithological classification. GABRIEL BERTRAND and HERMANUS L. DE WAAL: The comparative amounts of boron in plants cultivated on the same soil. Results of determinations of the amounts of boron in thirty species of plants: the boron found ranges from 2·3 mgm. per kilogram of dry material in barley to 94·7 mgm. in the poppy. The cereals contain the smallest amounts of boron. PIERRE LEJAY: Gravimetric map of Indo-China. From values of $g$ measured at ninety-seven stations a chart showing the anomalies of $g$ has been deduced. JEAN CABANNES, JEAN DUFAY and JUNIOR GAUZIT: The presence of radiations of wave-lengths below 3000 A. in the spectrum of the night sky, and the probable existence of two luminescent layers in the upper atmosphere. As a working hypothesis to cover the known facts, the existence of two light-emitting layers is assumed, one, at a very high altitude, directly excited by electronic collisions, the other, lower, connected with the transformations accompanying the formation or destruction of ozone. HARALD CRAMÉR: A property of the law of Gauss. PAUL VINCENSINI: Certain congruences of spheres. PER GOTAAS: Formulæ of recurrence for semi-invariants with some laws of distribution with several variables. S. MAZUR and W. ORLICZ: The divisibility of abstract polynomials. CHARLES BLANC: The type of Riemann surfaces simply convex. F. H. VAN DEN DUNGEN: The properties of oscillations. CHARLES JAEGER: The theory of the water 'hammer' in water mains with characteristic multiples. The case of periodic movements. PAUL SCHWARZ: The movement of Bénard-Kármán vortices in a rectilinear canal. A. LABARTHE and R. VICHNIEWSKY: Study of the vibratory phenomenon accompanying combustion in internal combustion motors. Photographic recording of the pressure-time diagrams by the Labarthe photo-cathodic method showed parts of the diagrams corresponding to the existence of a vibratory phenomenon with a frequency of about two thousand periods per second. It was proved that this was not due to period of vibration of the metallic membrane used. ALEXANDRE FAVRE: A new hypo-supporter method: wing with a wall of mobile extrados. RENÉ DUGAS: The reality of quantic mechanics. A discussion of Einstein's criterium of reality. RENÉ LEDUC and JEAN VILLEY: The yield of propelling tuyères. ALEXANDRE PROCA: The definition of the electro-magnetic field by potentials: the magnetic moment of the electron. MARCEL LAPORTE and MLLE. PIERREJEAN: The fine structure of the flashes of light obtained by discharging a condenser through a tube containing gas. GASTON DUPOUY: The thermomagnetic study of some salts of the rare earths in aqueous solution. HENRI BIZETTE and BELLING TSAÏ: The magnetic rotatory power of nitric oxide. The Verdet constant of nitric oxide, compressed to 90 kgm./cm.$^2$, for the green line of the mercury arc, is $-0{\cdot}0068'$. AUREL NAHERNIAC: Study of the absorption spectrum of alcohols in the near infra-red (about 1 $\mu$) as a function of the temperature up to the critical point and above. The curve showing the intensity of the OH band as a function of the temperature is given: this curve resembles the curve of densities up to the critical point. GEORGES DÉJARDIN and LEWI HERMAN: Remarks on the fluorescence of sodium salicylate. A. ROUSSET: Measurements of the polarisation in the spectrum of molecular diffusion of liquid carbon tetrachloride. CHARLES LAPICQUE: The retinal image of a distant point for different sizes of the pupil. JEAN CAHOUR: The hardness of electrolytic deposits of nickel. The hardness of the deposit varies definitely with the nature and physical state of the supporting metal. Factors tending to diminish the size of the crystals cause an increase of hardness. CLÉMENT DUVAL: Remark on the boiling point constants. ANDRÉ BOULLÉ: The potassium metaphosphates prepared by dehydration of monopotassium orthophosphate. The variations of viscosity of the colloidal solutions studied do not appear to correspond with changes of crystalline structure, and do not indicate with certainty the existence of varieties capable of existing at the ordinary temperature. MLLE. BLANCHE GREDY: Comparison of the Raman spectra of some *cis* and *trans* cinnamic derivatives. JOSEPH BIECHLER: Researches on the aromatic nitrogen substituted cyanamides. E. ZMACZYŃSKI: A reaction of sulphur and some ketone-alcohols in glycerol containing iron. A colour reaction capable of detecting 1 mgm. of sulphur in 1 c.c. of glycerol. LÉON ENDERLIN: Contribution to the study of the reversible oxidisability of organic compounds: a monoxide reducible but not dissociable of bis-$p$-bromophenyldiphenylrubene. PIERRE BEDOS and ADRIEN RUYER: 1.3-cyclohexadiene and on the structure of the monoepoxide of this hydrocarbon. F. BLONDEL and J. BONDON: The mineralisation of the Pre-Cambrian of the Anti-Atlas. A. LENOBLE: The discovery of a fossil fauna and flora in the schist formations of the schisto-quartzo-limestone formations of the centre of Madagascar. EUGÈNE AUBEL and FUSIO EGAMI: The deamination of alanine. ALBERT MAIGE: The physico-chemical properties of the plastidal stroma and imbibition. RENÉ SOUÈGES: The embryogeny of the Hypericaceæ. The development of the embryo in *Androsæmum officinale*. EMILE MIÈGE: The injurious influence of continuous culture of the potato on the level in Morocco (1934–1935). The results confirm the views of agriculturists, that the cultivation of the potato in North Africa is impossible without fresh importation of seed potatoes. P. LAMARQUE: Histo-radiography. HENRI BIERRY and BERNARD GOUZON: The spectral detection of the œstrogenic hormone in the urine of a pregnant woman. The method appears to be specific and sensitive. PIERRE FEYEL: The influence of the food regime on the renal secretion of urea in mice.

RAYMOND HAMET: Modifications of the physiological action of 3,4-dioxyphenyl-β-aminobutanol by the substitution of a methylamino group for the amino group of this substance. PH. L'HÉRITIER and GEORGES TEISSIER: The proportion of the sexes in populations of *Drosophila* in equilibrium. MAURICE LECAMP: The determination of the coaptative curvature of the anterior members in *Phasma*. MAURICE LEMOIGNE, PIERRE MONGUILLON and ROBERT DESVEAUX: The production of hydroxylamine by *Sterigmatocystis nigra* at the expense of ammonia. Hydroxylamine is formed by this mould either from nitrates or from ammonia. It thus appears to be a necessary term in the nitrogen metabolism of this plant. MAURICE PIETTRE: Researches on the proteins of yolk of egg of the fowl. CONSTANTIN LEVADITI and MLLE. RACHEL SCHOEN: The virus of rabies and neoplasmic cells.

CRACOW

**Polish Academy of Science and Letters**, January 13. F. LEJA: A class of series with real terms. T. BANACHIEWICZ: Photographic observations of Pluto. Pluto has been found on four negatives taken at Cracow on November 3–4 and 4–5, 1935, and its positions are given. M. KAMIENSKI and M. BIELICKI: The appearance of the Wolf Comet I in 1925. Results of calculations based on all the observations of this comet made in 1925, and a comparison of these calculations with the theory of the comet. J. NOWAK: The Upper Cretaceous in the conglomerate of Sloboda Rangurska. M. GATTY-KOSTYAL and J. TESARZ: Nucleic acid from ergot of rye. After carrying out a series of comparative analyses of the nucleic acids arising from ergot of rye and from yeast, the chemical identity of these substances has been established. MLLE. J. STUDENTOWICZ: The behaviour of annelids belonging to the species *Enchytræus albidus* under the influence of light. T. GARBOWSKI: The role of memory in a cat blind from birth. W. HEINRICH: Monocular stereoscopy. M. PODHOREDECKI: Fixing attention on the lateral parts of the field of vision. W. SZEWCZUK: Researches on optical illusions.

LENINGRAD

**Academy of Sciences** (*C.R.*, **4**, No. 3, 1935). L. V. KANTOROVICH: Some general methods of extension of Hilbert space. D. SHERMAN: Contribution to the solution of the second fundamental problem of the theory of elasticity in the case of a multi-connected plane. W. FREEDERICKSZ and W. ZWETKOFF: Movements arising in anisotropic fluids under the influence of an electrical field. P. T. SOKOLOV and S. L. SOSINSKIJ: Influence of electric fields on the viscosity of fluids. D. W. KONVISAROV: Plasticity of deformed metals. L. ISAKOV: A system of masses of light atoms deduced from nuclear reactions alone (2). N. N. KALITIN: Some data on the transparency of ice for the ultra-violet solar radiation. N. I. STEPANOV and S. A. BULACH: Rate of transformation in the magnesium-cadmium alloys. V. M. TIMOFEJEV: Absolute age of the oldest formations of Karelia. S. HELLER: Contribution to the problem of the connexion between gravity and seismic activity. L. I. SERGEJEV, A. M. LEBEDEV and A. A. AKIFJEVA: Correlation of frost resistance and resistance to soil salination. S. S. SMIRNOV: A new genus of Cyclopinidæ (Copepoda) from Anatcha Bay (Kamtchatka). W. W. POPOV: On the origin of the cell material during the formation of a heterogeneously induced extremity.

## Forthcoming Events

**Monday, April 6**

VICTORIA INSTITUTE, at 4.30.—Dr. R. E. D. Clark: "The Present Position with Regard to the Origin of Species".

**Tuesday, April 7**

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Robert Muir, F.R.S.: Lister Memorial Lecture.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Robert Hadfield, Bt., F.R.S., and S. A. Main: "Corrosion of Iron and Steel".

## Official Publications Received

### Great Britain and Ireland

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1934. Pp. 86. (Reading: The University.) [173

Institute for Research in Agricultural Engineering: University of Oxford. Farm and Machine, Vol. 3: Comprising the Report of the Institute for the Year ended September 1935 and the Proceedings of the Oxford Conference on Mechanization in Mixed Farming, 1936. Pp. 256. (Oxford: Institute for Research in Agricultural Engineering.) 3s. 6d. [173

Observations made at the Royal Observatory, Greenwich, in the Year 1934 in Astronomy, Magnetism and Meteorology, under the direction of Dr. H. Spencer Jones. Pp. vii + A74 + B10 + Cix + C57 + D66 + E46 + 24. (London: H.M. Stationery Office.) 25s. net. [183

London County Council. Guide to the Collections in the Horniman Museum and Library, Forest Hill, London, S.E.23. Fourth edition. Pp. 128. (London: P. S. King and Son, Ltd.) 3d. [183

Report of the Broadcasting Committee, 1935. (Cmd. 5091.) Pp. 77. (London: H.M. Stationery Office.) 1s. 3d. net. [183

### Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 501: Relation between the Physical Properties and Chemical Components of Various Grades of Geranish and their Attractiveness to the Japanese Beetle. By F. W. Metzger and W. W. Maines. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents. [183

Southern Rhodesia. Geological Survey Bulletin No. 29: Chemical Analyses of the Rocks, Ores and Minerals of Southern Rhodesia. By E. Golding. Pp. 105. (Salisbury: Government Stationery Office.) 5s. [173

Reports of the Biochemical Research Foundation of the Franklin Institute. Vol. 3: 1934–1935. Pp. v + 340. (Philadelphia, Pa.: Franklin Institute.) [173

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 2: The Storage of Trinidad Citrus Fruits. By E. R. Leonard. Pp. 47 + 10 plates. 2s. net. Memoir No. 3: The Storage of West Indian Mangoes. By C. W. Wardlaw and E. R. Leonard. Pp. 47 + 9 plates. 2s. net. (Trinidad: Imperial College of Tropical Agriculture.) [173

Année polaire internationale, 1932–1933. Participation française. Tome 1: Introduction, magnétisme terrestre, aurores polaires, ozone atmosphérique, rayons cosmiques. Pp. v + 414. (Paris: Gauthier-Villars.) 125 francs. [183

Contributions from the Physical Laboratories of Harvard University for the Years 1933 and 1934. Series 2, Vol. 1. 65 papers. (Cambridge, Mass.: Harvard University.) [183

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 1: Educational Directory, 1935. In 4 parts. Pp. iii + 41 + 27 + 58 + 47. (Washington, D.C.: Government Printing Office.) [183

Smithsonian Miscellaneous Collections. Vol. 94, No. 13: Morphology of the Coleopterous Family Staphylinidae. By Richard E. Blackwelder. (Publication 3343.) Pp. 102. (Washington, D.C.: Smithsonian Institution.) [183

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 88. Zoological Results of the George Vanderbilt Expedition of 1934. Part 1: Introduction and Itinerary. By James A. G. Rehn. Pp. 14. Part 2: The Forest Elephant of Africa. By Glover M. Allen. Pp. 15–44 + 4 plates. (Philadelphia: Academy of Natural Sciences.) [183

U.S. Department of Commerce: National Bureau of Standards. Miscellaneous Publication M 121: Units of Weight and Measure (U.S. Customary and Metric) Definitions and Tables of Equivalents. Pp. iv + 62. (Washington, D.C.: Government Printing Office.) 15 cents. [183

University of California Publications in American Archaeology and Ethnology. Vol. 35, Nos. 3, 4 and 5: A Karok World-Renewal Ceremony at Panaminik, by Philip Drucker; Karok Towns, by A. L. Kroeber; Wiyot Towns, by Gladys Ayer Nomland and A. L. Kroeber. Pp. 23–48. 1s. 3d. net. Vol. 36, No. 2: Sinkyone Notes. By Gladys Ayer Nomland. Pp. 149–178 + plate 4. 1s. 6d. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [203

Amani Memoirs. A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika, Zanzibar), with Explanatory Memoir. By G. Milne, in collaboration with V. A. Beckley and G. H. Gethin Jones, W. S. Martin and G. Griffith, and L. W. Raymond. Pp. 34 + map. (Amani: East African Agricultural Research Station; London: Crown Agents for the Colonies.) 5s. [203

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# Eugenics and Society

IF the Eugenics Society fashions its attitudes and policies in accord with the ideas and ideals presented to it in the Galton Lecture for 1936 delivered on January 17 by Prof. Julian Huxley, it will surely receive many and powerful reinforcements. Eugenics is destined to become part of the religion of the future, or of whatever complex of sentiments which may then take the place of organised religion. But, before it can become a soul-compelling ideal, it must first achieve precision and efficiency as a branch of applied science. It must devise new techniques which can cope with plurality of causation and plurality of effect, and can also design and explain an experiment in which rigorous control is not possible. Eugenics is much more than human genetics, for though it certainly aims at the improvement of the human race by means of the improvement of its genetic qualities, its policies must never disregard the obvious fact that such improvement implies a knowledge not only of the type but also of its habitat and destiny. Improvement, whatever form this may take, can only be realised in a certain kind of environment, and therefore, to the eugenist, a study of the environment must accompany a study of the genetic constitution of the stock.

In all comparisons of individuals, of social classes and of ethnic groups, it is impossible to assert that any observed difference in characterisation is a reflection of some fundamental genetic dissimilarity until it has been shown that it is not due, in the whole or part, to the impress of different environmental forces. Until the environment—housing, diet, education—is equalised, we have no right to the view that certain groups or classes who differ among themselves in visible characters are genetically dissimilar, and that therefore in relation to the conditions of the social environment some are superior and others inferior. It is the case that different ethnic groups, for example, differ in regard to the amount and to the range and type of variability of physical characters, and that these differences are, in the main, genetic. It is safe to assume, further, that these groups will be shown to differ genetically also in respect of intellectual and emotional characters, both quantitatively and qualitatively. But it is unlikely that these differences can ever account for the prejudices and antagonisms that separate the peoples.

Racial theories are nothing more or less than rationalisations of political prejudices, as shown by Prof. Huxley in his Friday evening discourse at the Royal Institution on March 27. So long as a half-caste remains an outcast, it is impossible to assess his biological or social worthiness. The social environment itself exercises a selective influence, attracting to it certain biological types and repelling others, favouring certain evolutionary trends and embarrassing others.

The eugenist must therefore consider, as a eugenist, the particular political and social structure of the community with which he deals. He must ask whether or not social success is synonymous with ultimate biological and human values, and also whether or not a competitive and individualist system, based on private capitalism and public nationalism, is in its essence of a nature eugenic or dysgenic. If the social system is not itself satisfactory, then the eugenist must aim at its transformation. Eugenists must familiarise themselves with the outlook and the concepts of sociology, with the technique and practice of social reform, for these are an indispensable part of the machinery the eugenists need if they are to realise their aims.

# An Empire Development Board

FOR some years past, Sir Robert Hadfield has advocated the establishment of an Empire Development Board in order to secure a systematic and co-ordinated or a 'planned' development of the vast resources and opportunities of the British Empire. He has now brought his suggestions together in a concise pamphlet* which, although prepared for consideration by a committee of the Institution of Civil Engineers, is deserving of the widest study. Sir Robert speaks with authority as a man of science, an engineer and as an administrator; and whilst drawing most of his examples from the field of engineering, he is clear that the membership of the Board should be fully representative of Empire scientific, technological and industrial activities.

The proposals are concrete and definite: a permanent body of adequately remunerated members continually at work and continually supplied with 'new blood' on an elastic basis of retirement by rotation, with a secretariat in each country and the main Board travelling frequently to all parts of the Empire. The Board would be non-political, and its aim would be to assist in developing new and additional resources, and *not* the guiding of existing trade into Empire channels by fiscal means. Its purpose would be to develop the Empire as a whole, and not to benefit one part at the expense of another. The Board would co-operate fully with all professional institutions, trade and industrial federations, as well as with the Governments of the constituent parts of the Empire, but would not itself control or manage existing or new undertakings.

* Empire Development and Proposals for the Establishment of an Empire Development Board. By Sir Robert Hadfield. Pp. 78. (London: Chapman and Hall, Ltd., 1935.) 2s. 6d. net.

Sir Robert is under no illusions regarding the magnitude of such an undertaking. He points out, in the first place, however, that the Dominions Royal Commission (1912–17) expressed with no uncertain voice the need for such a body and unanimously recommended the creation of an Imperial Development Board. There is thus evidence both of need and of prospective co-operation. In reply to the argument that the plan is too immense to be handled effectively by any single organisation, it is urged that the magnitude of the task is simply a measure of the opportunity, and that clearly some organisation to deal with the problems is in any event better than no organisation at all. With regard to the objection that the cost would be excessive, it is argued that productive work would be accomplished at comparatively small cost and that within reasonable limits the more spent on the work the greater would be the return, whilst a small fraction of the sums spent annually on the various legislative bodies within the Empire would supply an adequate income.

The proposals put forward by Sir Robert Hadfield would seem to be especially vital at the moment. We have at home a National Government which has already indicated its appreciation of one urgent Empire problem by setting up a Dominions Migration Board. The countries of the Empire are united by a common loyalty and a real brotherhood which cannot be but strengthened by the work of a common Development Board. As one by one political ties are loosened, there is real need for a new bond.

L. D. S.

# Method and the Science of Man

IF trenchant criticism of the methods employed in investigation affords any gauge of a healthy state in a given science, physical anthropology must be enjoying a peculiarly healthy activity. To recent attacks on racial classification on the basis of the measurement of physical characters may now be added criticism of both the accuracy and adequacy of bodily measurement itself. It may be remembered that Sir Arthur Keith was once criticised for relying on the evidence of the eye in racial discrimination. It was pointed out that in so doing he relied upon an inexact observation for evidence which was afforded more exactly by measurement. It should be remembered, however, that 'racial discrimination by inspection', to be effective, must be trained; while measurement itself, experience has shown, may be a source of error, if due precaution be not taken against the

personal equation and any technical deficiencies of the observer.

Two recent studies in the methods of anthropoid palæontology and physical anthropology respectively lend support, however, to Sir Arthur's view. In a lecture on "Evolutionary Parallelism and Human Phylogeny", delivered recently before the Oxford University Anthropological Society, Prof. W. E. Le Gros Clark (*Man*, 2 ; 1936) stresses the implications of the principle of convergence, whereby a group, though splitting off from the main stock, might follow a course of parallel development, which would result in a close resemblance to members of the cognate stock, or stocks, while masking important differences, which the methods of anthropometry, in so far as they depend on a summation of resemblances, or craniometry, relying, more or less, on a single character, would inevitably overlook. These all-important differences are often of a non-metrical character. Such, for example, are the shape and orientation of the nasal skeleton ; but they are not commonly taken into account in the biometrical treatment of the skull.

Prof. Le Gros Clark's reference to the nasal skeleton is of special interest in view of the fact that study of the nose is one of the principal sources of the data upon which Prof. V. Suk bases an attack on certain anthropometric methods, which constitutes the second of the studies to which reference is made above. In "Fallacies of Anthropological Identifications and Reconstructions" (*Pub. de la Fac. des Sci. de l'Univ. Masaryk*, Brno, Čis 207 ; 1935) he shows that not only does facial expression not depend upon the osseous parts, but also that when an actual dissection is made, a very considerable discrepancy appears between anatomical points fixed through the tissues and those located on the actual bones themselves. Prof. Suk, working with cadavera, was able to fix these points with much greater accuracy than is possible in the living, yet even so he found in the difference before and after dissection an error of four, five and even six millimetres in locating the nasion ; while the difference between the breadth of the external nose and that of the bony nose was sometimes so much as nineteen millimetres. One conclusion which emerges is that an index of the bony nose does not tell us anything about the external nose of the individual.

Taking into account the various points brought under consideration, Prof. Suk concludes that neither the reconstructions of early man—these he suggests are made under the influence of the Australian cast of countenance—nor the identifications of the bones of prominent historical characters by comparison of measurements with portraits, have any value. The further conclusion follows, in Prof. Suk's own words, "that that part of Anthropology, which is too much preoccupied with osteology and osteometry, loses any solid ground, when it does not take into consideration the whole body, for Man is not merely a skeleton".

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# The Cost of Health

**Food, Health and Income:**
Report on a Survey of Adequacy of Diet in relation to Income. By Sir John Boyd Orr. Pp. 72. (London : Macmillan and Co., Ltd., 1936.) 2*s*. 6*d*. net.

IN some of the recent controversial discussions concerning dietary standards applicable to human beings, attention was focused on minimum requirements. This report recently issued by Sir John Boyd Orr emphasises the need for defining the optimum diet, that is to say, one which is capable of maintaining a standard of perfect nutrition, which is "a state of well-being such that no improvement can be effected by a change in the diet". Although data do not yet exist for defining accurately this optimum diet, recent laboratory researches and dietary surveys have made it possible to indicate the amounts of some of the important constituents of a diet which are required to ensure good nutrition in certain classes of individuals. If such standards are accepted as furnishing an indication of the adequacy of present-day diets, it is possible to use existing data relating to the food consumption of the population of Great Britain to determine how far such diets are capable of supporting a state of good nutrition.

The mean quantity of each of the main varieties of food consumed by individuals in Great Britain could be calculated, and it would be a simple matter to determine whether this mean quantity

furnished a sufficiency of the individual food constituents considered necessary for good nutrition. It was, however, clear that the income of an individual determined to a considerable extent the kind of food he bought, and it was therefore a matter of greater importance to investigate the adequacy of existing diets in relation to the amount of money available for the purchase of food.

Data were obtained from various sources which suggested that it was permissible to divide up the population of Great Britain into six groups according to their weekly expenditure on food. This expenditure ranged from 4*s*. or less in group I to 14*s*. or more in group VI. From existing dietary surveys it was possible to estimate the average amount of common kinds of food consumed by individuals belonging to the various groups, and in this way some idea was obtained of the adequacy of the diet of each group for maintaining a state of good nutrition.

The main findings which emerged from this study were that, while the consumption of bread and potatoes was practically the same in all six groups, the consumption of milk, eggs, fruit, vegetables, meat and fish rose with the income. Thus in the poorest group an average of 1·8 pints of milk and 1·5 eggs were estimated to be consumed per head per week, while in the richest group the corresponding amounts were 5·5 pints of milk and 4·5 eggs. The poorest group apparently spent 2·4*d*. on fruit and the richest 1*s*. 8*d*. A detailed analysis of the diets indicated that the average diet of the poorest group, which comprises 4½ million people, was deficient in every food constituent examined. The diet of the second group, comprising 9 million people, was adequate in protein, fat and carbohydrate, but deficient in all the vitamins and mineral elements examined. That of the third group, also comprising 9 million people, was deficient in some of the vitamins and mineral elements, while the diets of the fourth, fifth and sixth groups approached or surpassed the standard of adequacy in regard to all the constituents examined. These results as a whole suggest that a diet adequate for the maintenance of perfect health is obtained by not more than one half of the population of Great Britain.

Investigations carried out in various parts of the world do in fact indicate that there may be a definite relation between the physiological adequacy of the diet and the physique, the incidence of disease and the death-rate. Such indications are obtained, for example, by comparisons of the physical measurements and sickness and death-rates of groups of individuals known to receive differing types of diet, or by observations of the effect on the physique and health of groups of individuals likely to be poorly nourished, when supplements of food of high nutritive value are added to their diet. If it is true that the health of a large section of the population of Great Britain is suffering as the result of faulty nutrition in the physiological sense of the term, it is difficult to escape from the conclusion that we are confronted with a problem which demands serious study by economists and politicians.

# 'Deutsche Mathematik'

**Deutsche Mathematik**
Im Auftrage der Deutschen Forschungsgemeinschaft, herausgegeben von Theodor Vahlen. Heft 1, January 1936. Pp. 112. (Leipzig: S. Hirzel, 1936.) Subscription price, 12 gold marks a year (6 issues).

THE periodical of which this is the first number appears under the general direction of Prof. T. Vahlen (*Herausgeber*), with Prof. Bieberbach as responsible editor (*verantwortliche Schriftleitung*). A short introductory statement announces that its aim is to give a living picture of the whole of the mathematical work of German comrades (*Volksgenossen*). It will therefore publish not only new results, but also informative articles for mathematicians of every kind, from student to original worker, with notes on congresses, camps, study groups and *Fachschaften*.

There are three parts, headed "Arbeit", "Belehrung", and "Forschung". In the last two are articles of a purely mathematical nature, including, in Part 3, a paper by W. Rinow on the topology and geometry in the large of spaces with a given Riemannian metric, and in Part 2 a historical account, by E. A. Weiss, of the development of Lie's theory of the "straight-line-sphere" transformation.

The "work" to which Part 1 is devoted is, of course, Party work. The first article, "Studenten, in Front!" is an exhortation, of a type now familiar, to intensive study of the problems of 'race-bound' creative work in mathematics, and is followed by accounts of work in mathematical labour-camps, and of a seminar at Heidelberg, in which the Germanic soul-structure of Kepler and Newton, as shown in their works, was contrasted with that of Einstein, whose theories were found

not to deal with assertions which can be tested experimentally or by astronomical observations. More remarkable than these works of students is an article by E. Tornier, now professor in the University of Göttingen, entitled "Mathematician or Juggler with Definitions ?", which informs the reader what mathematical theories are to be regarded as genuinely significant.

"Every theory of pure mathematics has the right to live if it is really capable of answering concrete questions about genuine objects, such as the whole numbers and geometrical constructs (*Gebilde*), or if it is at least capable of being used in the building up of such theories. Otherwise, either it is an uncompleted beginning (that is, when further building up can make it capable of application), or it is a document of Jewish liberalistic obscurantism, sprung from the intellect of rootless *artistes*, who by juggling with definitions referring to nothing, conjure up mathematical creativeness before themselves and their empty-headed clientèle, a clientèle which is glad slowly to learn off a few tricks, in order to shine as third-rate Rastellis before still humbler audiences."

Whether the author of this outburst had any definite branches of modern mathematics in his mind when he wrote it is difficult to say, since there are few mathematical theories, Germanic or not, which have not some application to the 'genuine objects' he mentions, if suitably interpreted. It was at any rate a slight relief to the reviewer to find that among the original papers in Part 3 there are several which deal with abstract axiomatic theories.

The whole journal, including the mathematical papers, is printed in German type. M. H. A. N.

# Progressive Physics

**Reports on Progress in Physics**
Vol. 2. General Editor: Allan Ferguson. Pp. iv+371. (London: Physical Society, 1936.) 21*s*. net.

THE second volume of the Progress Reports issued by the Physical Society does not belie the promise of the first. It continues the method, initiated in the earlier volume, of a series of reports dealing with the main content of physics issued under the same heads as appear in the first volume. It is to be presumed that these heads—general physics, the quantum theory, atomic physics, sound, heat, optics, spectroscopy, X-rays, and electrical and magnetic measurements, will appear regularly in the succeeding volumes. Over and above these come the titles of special reports which will vary from year to year—reports concerned with topics which are, it may be, of specialised interest, or which chronicle some of those rapid and spectacular advances of which almost every year has its share. The special reports which appear in the present volume are of remarkable and varied interest.

A very timely contribution from Prof. H. R. Robinson deals with the charge ($e$) and specific charge ($e/m_0$) of the electron. When Birge's well-known report was published in 1929, two widely-differing values of $e/m_0$ held the field; direct deflection methods gave the value $1{\cdot}769 \times 10^7$, spectroscopic methods $1{\cdot}761 \times 10^7$. The value of $e$, on the other hand, was assumed to be known very exactly. To-day the situation is reversed; the spectroscopic and deflection values of $e/m_0$ are in close agreement, whereas two competing values for $e$ exist, which are to each other almost in the mystical ratio 136/137. Obviously a critical discussion was needed, and this has been admirably furnished by Prof. Robinson.

The methods developed and employed in geophysical prospecting are fully and critically discussed by Mr. Lancaster-Jones, and Prof. E. V. Appleton contributes a long report of absorbing interest which deals with radio-exploration of upper atmosphere ionisation. The important subject of electron tubes is handled, under the general editorship of Prof. G. I. Finch, in four sections, two of which—a general introduction, and a section on the electron-diffraction camera—are contributed by Prof. Finch himself. The other sections deal respectively with the electron microscope (Mr. H. J. H. Starks), and the high-speed cathode ray oscillograph (Messrs. Miller and Robinson).

There are two matters of outstanding interest that rise at once to mind when one turns over the pages of so comprehensive a report as this one. The first concerns the content and balance of the report, and it may as well be confessed at the outset that a report which shall satisfy all-comers in this respect is never likely to materialise. Each specialist tends to belaud his own brand of leather, and while the quantum physicist deplores the space given to the dweller in macroscopic regions of thought, the technical researcher loudly proclaims that the atomic physicist is the spoilt child of his generation. On the whole, this volume of the reports holds the balance remarkably well.

Dr. N. Feather devotes twenty-three pages to a brilliant discussion of recent advances in atomic physics, and, under Prof. G. Temple's general guidance, the forty-seven pages of the section on quantum theory are divided into four subsections dealing respectively with the quantum theory of atomic nuclei, the spectra of polyatomic molecules, the quantum theory of valency, and the theory of paramagnetism in ionic crystals.

The remaining sections contain much matter which comes under the heading of atomic physics, and this branch of the subject certainly has its fair share of the content of the book. For the rest, classical and technical physics play their part, and no more than their part. If a suggestion may be put forward for the consideration of those responsible for future reports, it is that many would welcome a little more space given to the discussion of some of those problems wherein physics touches the regions of psychology and physiology (this by no means implies that these topics have passed unrecognised in the present report).

The other matter concerns the limits of appeal of the report. Broadly speaking, there are three levels at which a report may be written—we do not propose to discuss the difficult question of the assignment of "higher" or "lower" to any of these levels. But a report may be written to appeal to the layman at one end of the scale, and to the specialist at the other end, or it may steer a middle course, in that it may be written, in the instance of a report on physics, for the physicist who is not necessarily a specialist in the particular section which he may wish to read. The Physical Society's Reports endeavour to make the double appeal to the specialist and to the physicist who is not a specialist, and certainly a number of the sections succeed in combining these appeals; others frankly endeavour to help the specialist to keep abreast of his subject; all are thoroughly readable and are fully documented.

One need say no more concerning the externals of the volume than that it is a production of the Cambridge University Press; type, paper and binding are alike of first-rate quality, and the volume is excellent value for the money. No research worker in physics can afford to ignore it, and the volume should find a place on the shelves of every library which has a section devoted to physical science.

# Chemistry of War Gases

**Die Chemie der Kampfstoffe**
Von Dr. Mario Sartori. Aus dem Italienischen übersetzt von Dr. Hans Klumb. Pp. viii+259. (Braunschweig: Friedr. Vieweg und Sohn, 1935.) 18 gold marks.

THIS is a well-arranged compilation of the available information about the substances which were actually used in the Great War, or which were about to be used when hostilities ceased. Some fifty substances are dealt with, and for each of them there is a brief history of its discovery and of its use in the Great War, followed by descriptions of the methods of preparation in the laboratory and of manufacture, where known. The physical and chemical properties are given, together with a brief statement of the physiological action, and in some cases methods of detection and estimation in the air. This descriptive matter occupies four-fifths of the volume.

At the end of the book there is a table giving the substances that were actually used in the War, arranged in the order of their introduction. There are thirty-one entries in this list, which also gives a considerable amount of tabulated information about them. Another table contains seventeen substances which were prepared and investigated during the War, but did not actually come into use.

At the beginning there are three short chapters of a more general character. The first discusses some of the physical properties of a few of the more important substances: their densities, vapour pressures, volatilities, boiling points, melting points, persistence and stability. Some of these properties are, of course, closely related; the higher the vapour pressure of a substance, the lower is its boiling point, the greater its volatility and less time will it persist when scattered on the ground. The class of sternutators, which are derivatives of diphenylarsine, is, however, to be reckoned among the non-persistent substances, in spite of their very low vapour pressures, because they are used in the form of smokes, or aerosols.

The second chapter deals with the relation between chemical structure and noxious action. In many cases similar compounds are seen to produce similar effects, as in the case of the sternutators, or 'nose gases', just mentioned. Many of the lachrymators, or 'tear gases', contain the group $.CH_2X$, where X is a halogen, and some contain the ketonic group :CO, but this does not apply to all of them. The very important group of vesicants, or blister gases, consists practically of

only two substances: mustard gas, $S(CH_2.CH_2Cl)_2$, and lewisite, $CHCl{:}CH.AsCl_2$. Their action both on the skin and the other organs is very similar, but it is difficult to see much resemblance in their constitution except that they both contain chlorine. Most of the other noxious gases also contain one or other of the halogens, but they have practically no action on the epidermis. The other constituents that go to make a substance noxious appear to be sulphur, arsenic and $.NO_2$ and .CN groups, but why some substances are so much more effective than others is not always easy to understand. The property of being soluble in the body fats is probably of importance.

The third chapter discusses the classification of 'gases', but is not very helpful. In the body of the book the substances are arranged according to the toxic elements and groups that they contain, which probably is most convenient in a purely chemical work, but in practice these substances are generally classified according to their principal physiological action. A. MARSHALL.

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**Die Fermente und ihre Wirkungen**
Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 1. (Bd. 1: Specieller Teil: Hauptteil 7–15.) Pp. 160. Supplement. Lief. 2 (Bd. 1, Specieller Teil, Hauptteil 8). Pp. 161–320. Supplement. Lief. 3 (Bd. 1, Specieller Teil: Hauptteil 8, 9). Pp. 321–480. (Den Haag: W. Junk, 1936.) 28s. each.

PROF. C. OPPENHEIMER'S "Enzymes" has established for itself the position of a 'museum' of reference and information on this ever-growing subject. Such status is accompanied by the disadvantage that the complete work becomes too costly to possess individually and to replace by new editions even by the libraries. Yet if it is not kept up to date, especially in a subject which moves so rapidly, its utility rapidly lessens. To meet this difficulty, it is being re-issued in the form of a supplement to the special parts, which are those most useful for the scientific worker, and not to the complete work. Following the German practice, this supplement is appearing in parts, the first three of which are before us. The whole is to comprise two volumes, and is to be complete in ten parts within about two years at a cost of £8 10s. 0d. to those who subscribe in advance.

The present parts deal with the esterases, in particular the lipases of animal and vegetable origin, and the carbohydrases, covering both the enzymes which split the various glycosides and the amylases. As before, every effort has been made to cover adequately the enormous and confusing literature of this vast subject, and there is at least evidence that more attention is being paid to the English and American publications. Any criticism in detail is obviously impossible: our reading satisfies us that the work has been carefully done, and that it is closely up to date.

**Modern Surveying for Civil Engineers:**
the Practice of Surveying, Estimating and Setting out Works of all Kinds, including Chapters on Modern Photographic and Aerial Surveying as applied to Engineering Enterprises. By H. F. Birchal. Pp. xi+524+26 plates. (London: Chapman and Hall, Ltd., 1935.) 25s. net.

MANY books have been written on geodesy and surveying for civil engineers and surveyors, and of their authors many are engineers with Colonial experience. The volume under notice falls within the latter category, and therefore must be considered from this point of view.

The impression obtained is that the work will be extremely useful to an engineer in the Colonies who has already had some experience of the subject, and this alone would justify the brevity of treatment of the sections dealing with such matters as the calculation of closed theodolite traverses, the principles of levelling, and the methods of setting up of a level, theodolite or tacheometer. Many teachers of civil engineering would probably join with the reviewer in questioning the advisability of omitting the study of practical astronomy, while it would perhaps have been preferable if the consideration of circular curves had preceded that of transition curves, instead of following it. The standard method of finding the constants of a tacheometer in the field is not given, while Fig. 30 on p. 24 is wrongly drawn. In other respects, the work is exceedingly well illustrated, though some of the illustrations would repay full lettering and description.

The sections which deal with actual examples of large surveys of civil engineering works in the Colonies are very interesting and well set out, and should appeal to readers whose practice involves problems of such a kind. B. H. K.

**Introduction to Vertebrate Embryology:**
a Textbook for Colleges and Universities. By Prof. Waldo Shumway. Third edition, revised and enlarged. Pp. xii+390. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20s. net.

IN recasting his excellent text-book of vertebrate embryology for a third edition, Prof. Waldo Shumway has incorporated much new material, especially summarising the results of recent experimental research, but has maintained the lucidity and suggestiveness of the previous editions. In its new form, the book is an admirable introduction to cytology and genetics and a clear exposition of the new work on organisation, which has recently acquired fresh distinction by the award of the Nobel prize to Prof. Spemann.

Its value to the student is enhanced by the technical information about microscopy and the methods of histological procedure. Altogether it forms an admirable introduction to embryology and genetics which can confidently be commended both to students and teachers of this important part of anatomy.

**A Text-Book of West African Agriculture :**
Soils and Crops. By Dr. F. R. Irvine. Pp. xiv+348+32 plates. (London : Oxford University Press, 1934.) 7*s*. 6*d*. net.

For an English doctor of science to write an agricultural text-book for native West African students can be no easy task, and only the West African reader can say how far Dr. Irvine has succeeded in his objects. The outlook of the African native towards soil science must, for example, be different from that of the European, and require a different mode of presentation from the teacher. Dr. Irvine has, however, succeeded in compressing into seventy pages a most lucid and simply expressed account of the essential points of soil science, and although this involves some degree of over-simplification, it always affords at least as adequate an explanation of fact and is as intelligible as the more orthodox point of view.

The main part of the book is devoted to descriptions of the cultivation of almost every crop that is or might be grown in West Africa, and should be of great value not only to the students of Achimota College, but also to all who wish to know the rudiments of tropical agriculture and economic botany. Dr. Irvine is cautious in recommending the adoption of modern European methods and implements into African agriculture, confining himself to descriptions rather than to praise of the achievements of more northerly civilisations. This is an excellent feature, and shows a deep understanding of the needs of the readers for whom the book is primarily intended, and by pointing out the virtues as well as the failings of the time-honoured systems of native agriculture gives the book an added value to the English reader.

The book is well produced and fully illustrated with plates and diagrams.

**Our Enemy the Termite**
By T. E. Snyder. Pp. xii+196. (Ithaca, N.Y. : Comstock Publishing Co., Inc., 1935.) 3 dollars.

The author of this book has been associated, as an entomologist, with the U.S. Department of Agriculture since 1909. During this period he has been chiefly occupied with the investigation of termites, and other wood-destroying insects, and his original writings on these subjects are known to most entomologists. Much of the first-hand knowledge, thus acquired in an official capacity, is incorporated in a general way in this useful manual. The species of termites discussed are those native to the United States. While these 52 species represent only about 3 per cent of the world's termite fauna, the limitation is offset by the fact that most phases of termite biology are discussed. Dr. Snyder's book is, in fact, an authoritative introduction to the complexities of termite economy. The subjects of castes, reproduction, colony founding, growth, food, inquilines and other phenomena all come in for treatment.

The biological aspect of termite life is followed by chapters dealing with the relationship of these insects to man. The damage they bring about to buildings, crops and other property is well known, but relatively few people understand the ecological principles underlying effective control. Dr. Snyder has much to say on this subject ; he is an advocate of the adoption of proper codes for building construction as a means for prevention, and explains the procedure to be adopted. The numerous clear illustrations, mostly taken from the author's published papers, add to the value of the book. While it is to be commended to the biologist, its clarity of style, and the addition of a glossary of unfamiliar terms, renders it easily understandable by the layman. A. D. I.

**Weeds**
By Prof. W. C. Muenscher. (Rural Science Series.) Pp. xxii+577. (New York : The Macmillan Co., 1935.) 25*s*. net.

Trade in plant products between widely separated countries has brought with it an interchange of the weeds of cultivated land. By the spread of Western civilisation to all parts of the world, there has resulted a preponderance of European weeds among the emigrants to other temperate regions. North America is no exception. A survey of this weed flora of the northern part of the United States shows that a large proportion of the adventive weeds are from Europe. The wide range of many weeds therefore renders a weed flora of more than local interest.

The problem of weed control is twofold, for it is necessary first to identify the plant concerned before it is possible to choose the most suitable means for destruction. Both of these aspects of the problem are dealt with fully in this book. Chapters are devoted to agencies of weed dispersal, means of circumventing weeds, and weeds of special habitats. Mechanical and chemical methods of weed control are discussed in concise manner, but with sufficient detail to allow of their application by the practical farmer. Numerous references are given to modern research in this field. The bulk of the volume consists of a flora in which about five hundred weeds are described, suitable means of destruction being suggested for each. Many excellent line drawings, an artificial key to the species and a glossary should all increase the value of the work to the layman.

**Electron Diffraction**
By R. Beeching. (Methuen's Monographs on Physical Subjects.) Pp. viii+108. (London : Methuen and Co., Ltd., 1936.) 3*s*. net.

The increasing interest manifested in problems of surface and molecular structure is sufficient justification for the appearance of this very clear and well-balanced little monograph, quite apart from the excellent practical illustration which it gives of the principles of wave mechanics. In the scope of a hundred pages, the author has discussed electron wave properties, the early history of the experimental side of the subject, diffraction by transmission and by reflection, apparatus and technique, and the principal types of problem suited to investigation by electron diffraction. The book may be strongly recommended as a most useful review of the subject.

A. F.

# The Galactic Nebulæ*

By J. H. Reynolds

THE relationship which exists between the dark galactic clouds, the luminous diffuse nebulosities and the involved or neighbouring stars is now generally recognised, but it has been only during the last twenty years or so that the real connexion between them has become evident, owing principally to the work of Slipher and Hubble. The luminous nebulosities, such as that surrounding θ Orionis and ρ Ophiuchi, are regions on the near side of obscuring clouds, illuminated by stars within effective range. The medium composing the clouds is lit up in two ways, depending on the temperature of the stars involved. Stars of *B0* type and higher temperatures excite and ionise the atoms of the cloud by intense ultra-violet radiation, the resulting characteristic radiations being principally hydrogen, oxygen (singly and doubly ionised in the metastable state), and helium. With stars of lower temperature than *B2*, the illuminated cloud gives a continuous spectrum of the same type as the stars, which we may reasonably interpret as reflected light, while nebulosities surrounding intermediate stars show a combination of both types of spectrum.

Although the great advance in nebular astronomy during the present century has been entirely due to photography, since the pioneer work of Common and Roberts in Great Britain, and Keeler in America, the blotting out of the involved stars by over-exposure has had the effect of masking the apparent luminosity relationship between the stars and the surrounding nebulosity, so that some of the galactic nebulæ came to be regarded as independent formations. As an example of this I may mention Wolf's photograph of Nebula N.G.C. 7023 in Cepheus (Fig. 1). No one would think from the photograph that any star was involved in the nebula at all, although it is in fact the nebulosity surrounding the star B.D. 67°.1283. This brings me to a point which seems not to have met with the consideration it deserves, and that is the real relationship between the magnitude of the star and the surrounding nebulosity. It is evident that the apparent relationship depends for one thing on distance. If, for example, the Great Nebula in Orion were twice its actual distance the involved stars would be reduced to a quarter of their present brightness, while the apparent luminosity of the surrounding nebulosity would be still the same as at present, although reduced in size to half its angular diameter.

* From the Presidential Address delivered to the Royal Astronomical Society on February 14.

There is another complication introduced by the type of instrument employed. Broadly speaking, the apparent brightness of a star in the telescope depends on aperture, while the brightness of the surrounding nebulosity depends on focal ratio. By using a short focus reflector or lens we can increase

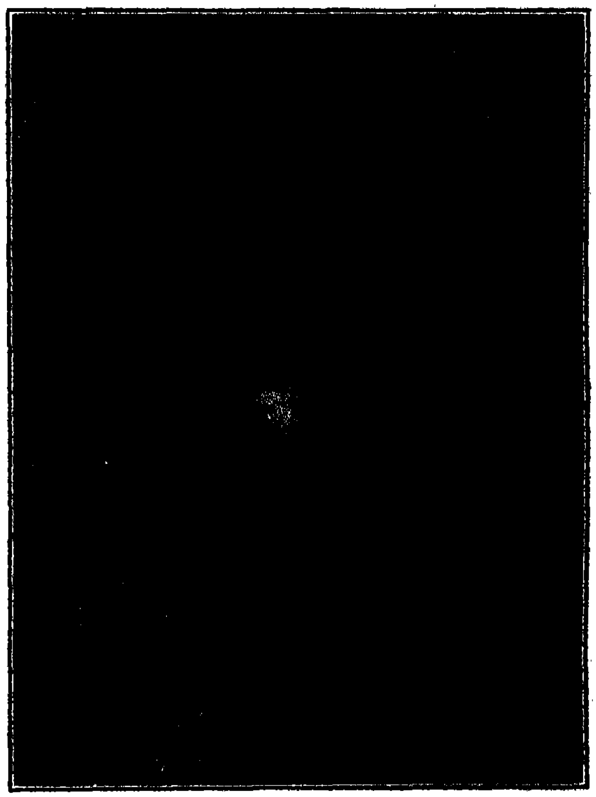

FIG. 1. Star involved in nebulosity, N.G.C. 7023.

the intensity and extent of a nebulosity; but the photographic result is apt to give a very erroneous impression of its real brightness, or rather faintness. A third modification is introduced by the three dimensional form of the nebulosity, which makes it impossible to say what is the real local distribution of intensity in an irregular cloudlike formation. It seems, therefore, impossible to measure the true ratio of intensity between any particular point of nebulosity and involved stars; but it is possible to measure with advantage the light distribution in planetary nebulæ, as these are usually symmetrically shaped formations, and consist of concentric gaseous shells transparent to their own radiations.

The first to realise the true character of the dark obscuring clouds in the Galaxy was Barnard, who

used a 6 in. short focus lens. Their extent must be enormous, as they cover many square degrees of the sky in Orion, Cygnus and other regions in and about the Galaxy. Their edges are usually luminous, although there are some well-known exceptions to this. Thus the North America Nebula in Cygnus is really the luminous edge of an extensive dark cloud (Fig. 2). On one side of the bright edge star-counts give only 10 per cent of the number on the other, where the normal stellar background of the Galaxy is shown with little or no obscuration. The same applies to the long filaments of nebulosity N.G.C. 6960, 6992 in Cygnus, although in these cases the disparity of star-counts on either side is nothing like so marked, owing either to a shallower depth of the absorbing medium, or a greater rarefaction, or both in some degree. There seem to be indeed all degrees of density of the absorbing medium between complete opacity at a shallow depth, such as the dark nebulosity near ζ Orionis, and a scarcely perceptible dimming of the stars by a light veil.

We come now to the important question of the composition of these clouds. In the case of the Orion Nebula and others giving a gaseous spectrum, we have quite definite evidence as to their nature. They consist of hydrogen, singly and doubly ionised oxygen in the metastable state, and helium. These radiations extend for a range of about eight light years from θ Orionis if we take the usually accepted distance of 180 parsecs. As might be expected, the singly ionised oxygen represented by λλ 3727/9 extends much farther away from θ than λλ 5007, 4959, the radiations of doubly ionised oxygen. Hydrogen seems to be almost co-extensive with singly ionised oxygen, while helium is found mostly in the central regions. We have therefore to deal with elements of low atomic number, which form a large part of our own atmosphere. It seems curious that there is not more evidence of nitrogen in these clouds, another gas of low atomic number and very widespread in our atmosphere. The explanation seems to be that singly ionised nitrogen in the metastable state has two strong radiations at λλ 6584, 6548, but no other radiations occur within accessible range.

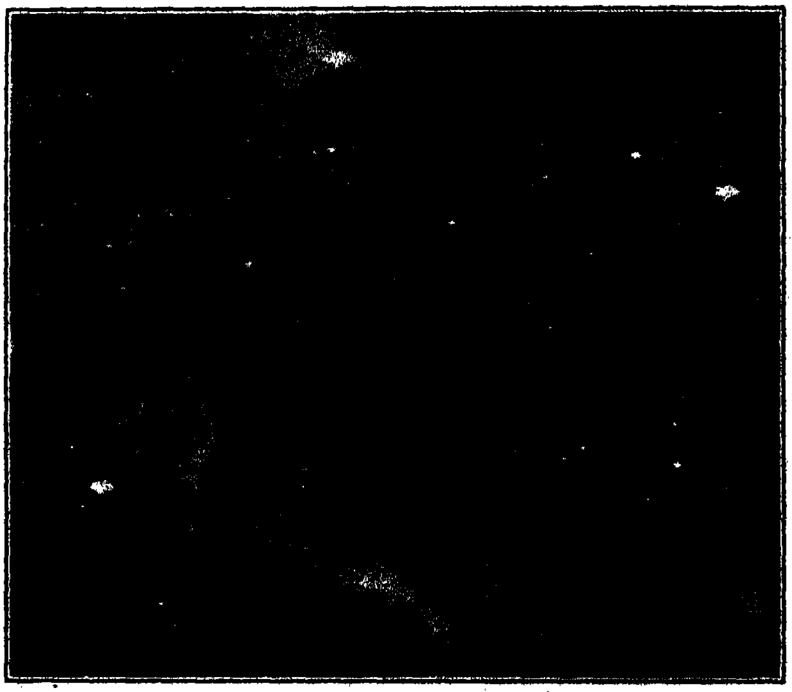

FIG. 2. North America Nebula in Cygnus, N.G.C. 7000.

Both these radiations are conspicuous in some of the planetary nebulæ, although I cannot find that they have been identified yet in the Orion Nebula.

It has often been assumed that the clouds must consist of solid particles owing to the fact that they reflect the light of neighbouring stars, and have a strong absorbing effect. But there is definite evidence that there can be no considerable amount of solid particles in the gaseous nebulæ, as such particles would tend to absorb the radiations from the gases, and give a continuous spectrum. It is now generally accepted that the characteristic radiations of the gaseous nebulosities are due to the ionisation of the gases in the cloud by the strong radiation of ultra-violet light or streams of electrons emitted by the high-temperature stars involved. When the effective distance limit of this ultra-violet radiation is passed, the atoms being no

longer ionised would naturally be present in their neutral condition. There seems to be no valid reason why these neutral atoms should not form molecules, and even enter into combination with atoms of other elements to form molecules of water vapour and, if nitrogen is present, of ammonia. Owing to the low temperature of interstellar space, such molecules could scarcely exist in a gaseous or liquid form. Is it not, therefore, possible that the 'dust' which causes the reddening of the light of stars involved in or behind the clouds, and reflects the light of stars of temperature lower than *B*2, may be particles of frozen water vapour and perhaps ammonia? In any event, all the evidence we have is that only gases of low atomic number are present; but we do not know enough of the physical conditions to answer the question.

Perhaps the most extraordinary examples of the 'reflexion' nebulæ are the 'variable' nebulæ. Three of these are known—Hind's variable nebula in Taurus, near τ Tauri, N.G.C. 6729 in Corona Australis, and Hubble's variable nebula in Monoceros. All three are connected with variable stars and dark obscuring clouds, but it is the last two that are specially interesting.

Knox Shaw has made a detailed study of N.G.C. 6729, in the Helwân Bulletins. The dark cloud against which the variable nebula is projected is very dense, and the edge is not illuminated, although there are two conspicuous patches of luminous nebulosity surrounding two stars, which must be on the near side of the cloud. The form as well as the brightness of the nebulosity varied to some extent with the magnitude of the star, but there was only a rough correlation between the two. The projected outline of both N.G.C. 6729 and Hubble's Variable Nebula is comet-like, and is comprised irregularly within an angle of 60° with the variable as the apex.

The illumination of the nebulosity N.G.C. 6729 is consistent with the idea that the light of the variable star is transmitted to the cloud with the velocity of light, if a distance of about 120 light years is accepted. But the most striking evidence for this is afforded by Slipher's spectrographic investigation of these two variable nebulæ, for both the stars and the nebulosities gave a spectrum similar to the earlier spectrum of novæ. Bright hydrogen lines are specially conspicuous, with absorption on the edges of shorter wave-lengths, and bright helium also appears with many other radiations found in Nova Aurigæ at an early stage.

FIG. 3. A planetary nebula, N.G.C. 7635.

Although the planetaries give the same type of spectrum as the gaseous diffuse nebulosities, they are totally distinct in their origin and characteristics. There is no doubt now, I think, that they originated as new stars. The concentric, or almost concentric, shells of gas were blown out from a nova at the original outburst, and have been travelling outwards for many thousands of years in most cases, at velocities slow compared with those of the original outburst. Nova Aquilæ in 1918 was the first of these outbursts to give us the clue, and Campbell's classic work on the planetaries, of which details can be found in the *Lick Obs. Bull.*, vol. 13, gave us the corroborative evidence we wanted. It is true that Nova Persei in 1901 showed a rapidly expanding luminous shell,

but this Kapteyn interpreted at the time as the passage of light outwards in a cloud. This explanation still holds good, as the parallax of this star is so small that no other seems to account for the extremely rapid growth of the shell. In six months it had expanded to an angular distance of between 6′ and 7′ from the star. This first luminous ring was followed by a much smaller nebulous envelope which had expanded to about 30″ in diameter by 1926. It is of irregular form, and from the curious hook-like form of its spectral lines is still expanding at a considerable rate.

The great majority of planetary nebulæ are almost symmetrical about an axis, and are either elliptical or circular in outline. In some cases the gases are concentrated in the outer rim of the shell and it is not so long ago that 'ring' nebulæ were differentiated from the planetaries in the catalogues, the N.G.C. for example having a different symbol for each.

We know now, of course, that the central stars which are of *O* type, and probably dwarfs, are the cause of the illumination of these enormous globes and shells of gas, by strong radiation in the extreme ultra-violet. The slitless spectrograph of the Crossley reflector at the Lick Observatory gave separate images along the spectrum, and the comparative diameters of these show much the same sequence as the diffuse gaseous nebulæ. The smallest images are helium and doubly ionised oxygen, and the largest are singly ionised oxygen (both in the metastable state), and hydrogen. In a good many cases singly ionised oxygen is not represented at all.

Like the new stars, the planetaries usually are found near or in the Galaxy, and their parallaxes are small. But if novæ are responsible for the planetary nebulæ, how is it that we do not find them on the sites of well-known outbursts in the past ?

Tycho Brahé's great nova of 1572, which equalled Venus in brightness, was situated in Cassiopeia in declination 61° and about one and a half degrees from $\kappa$, according to his observations, which were taken with great care. After allowing for precession, we can determine the locality of the outburst to-day, but although a search has been made, there is no trace of a planetary nebula within 8° of it. Tycho Brahé's nova was not the first in this region, for two others were reported in old chronicles in the region between Cassiopeia and Cepheus. One occurred in A.D. 945 and another in A.D. 1264. There is, however, a very unusual type of planetary in R.A. $23^h 16^m$, Dec. +60° 39′ (Fig. 3), lying about 8° away from the site of Tycho's nova, and it may be that this is the result of one of the earlier outbursts. It differs from all other planetaries in the fact that the bright illumination of the clearly defined outline over about 80° of arc is due, not to a central star, but to an eighth magnitude star probably outside the shell altogether. The contour of the rest of the disk, which is only visible in part, is about 3′ in diameter, which at a distance of 200 light years would represent 0·3 of a light year in diameter.

It would seem that if the radiation from the central star falls below a certain temperature, and no longer extends into the ultra-violet, the whole nebular shell disappears, so far as visibility is concerned. This is only what we might have expected, but we are still left with the difficulty of explaining its continued existence at all as a shell of gas, if the spheroidal form is the result of a balance between gravitation and radiation pressure, the basis of most of the theoretical work on the subject. It is possible of course that it is no longer entirely gaseous, as there is some evidence of obscuration. This unique object at any rate shows us that there may be invisible as well as visible planetaries.

The researches of Keeler, Campbell, Moore, Wright and Curtis at the Lick Observatory on the planetaries were undoubtedly the most complete ever undertaken at a single observatory. Besides the direct photography with the 36-in. Crossley reflector, and the work with the slitless spectrograph, a spectrograph with a slit and high dispersion attached to the 36-in. refractor revealed the fact that some of the planetaries were still in motion radially, and also in slow rotation.

With the slit placed across the major axis when the outline was elliptical, the lines at $\lambda\lambda$ 5007 and 4959 were found to be either doubled or widened in the middle, and the ends of lines were slightly twisted in some cases. This doubling or broadening of the lines is naturally interpreted to-day as a measure of expansion or contraction, although Campbell did not agree with this view, but the twisting and inclination of the lines he explained himself as a rotation effect.

The most striking feature of the *O* type nuclear stars is their great and increasing intensity towards the ultra-violet end of the spectrum. The maximum radiation seems to be actually beyond the atmospheric limit of $\lambda$ 2800, while the visual range is unusually faint. This explains why the central stars were missed in the days of visual observation, and why they come out so readily in photographs. Instead of colour excess, such as we find in the stars involved in the clouds, we find a large colour deficiency. It is difficult to give a reason for this faintness of the visual spectrum. It can scarcely be actual and we are led to think that there must be some physical effect in the mechanism of excitation of the gaseous shell which weakens the transmission of the longer wave-lengths but allows the ultra-violet to pass without loss of energy.

# The Mean Annual Loss of Life during Earthquakes

By Dr. Charles Davison

It is always difficult to make an accurate estimate of the number of lives lost during a great earthquake, and impossible in such disasters as those of Lisbon in 1755 and Messina in 1908. For Lisbon alone, the estimates vary between 30,000 and 70,000; but the bodies were removed from the city in masses without being counted. In the Messina earthquake, the first estimates gave 150,000 as the number of persons killed. A later report reduces the figure to 82,000, but, as it includes more than 32,000 "presumed killed", the real number may be about 50,000. In the great Japanese earthquake of 1923, there is the same uncertainty. According to the official estimates, 99,331 persons are known to have lost their lives, but there were also 43,476 reported as missing. In all cases in which the figures differ widely, the mean of the greatest and least is taken in the estimate that follows.

In an attempt to determine the average annual loss of life from earthquakes, it is necessary to include the earthquakes that occurred during a considerable interval. If this were not done, the effect of a small number of losses so great as that of the Japanese earthquake of 1923 might unduly distort the average. In that here given, the earthquakes of the two centuries 1735–1934 are taken, with the exception of the Calcutta earthquake of 1737, for which the report of 300,000 persons killed seems doubtful. The well-known Milne scale of intensity for destructive earthquakes is used, though earthquakes of the lowest degree are omitted, as they contribute but slightly to the loss of life.

During the two centuries mentioned, the total number of deaths in 135 earthquakes of the third degree of intensity in the whole world was 1,044,606, and in 61 of the second degree 2,125, leading to averages of 7,738 and 35 per earthquake. In the last century (1800–99) covered by Milne's catalogue of destructive earthquakes, there were 360 and 510 earthquakes of the two intensities. At the above rates, the total number of deaths per century would be 2,785,680 and 17,850, giving 28,035 as the average loss per year.

The average annual rates obtained in the same way for certain important earthquake districts may be given. They are as follows: 13,862 in China, 7,980 in Colombia and Ecuador, 2,240 in Japan, 1,006 in Italy, 991 in Central America, 715 in India, 586 in Persia, 550 in Asia Minor, 99 in Greece, 35 in the Philippines, 29 in Formosa, and 6 in the United States. In addition to the above regions, there is a number of others, such as Spain, Portugal, Venezuela, Algeria, etc., in which the numbers of earthquakes with known losses of life are too small to give satisfactory results separately. Grouping them together as a single district, the corresponding average number of lives lost per year is 2,380. The sum of all the above numbers is 30,479.

Thus, remembering the uncertainty of some of the estimates on which we have to depend, it would seem that the average number of lives lost every year in the earthquakes of the whole world is about 28,000–30,000. Of the two figures, the smaller is probably the more accurate, because the larger the region, the less will be the disturbing effect of the most destructive earthquakes.

# Obituary

## Vice-Admiral H. B. T. Somerville, C.M.G.

The tragic death on March 24 of Vice-Admiral H. B. T. Somerville has removed from the world one who was imbued with the spirit of service and who, throughout his whole life, set an example of steadfast endeavour in all the duties which he was called upon to perform.

Boyle Somerville was blessed with good health, a strong sense of humour, a good voice, all the charming characteristics of the best type of Irishman, and won the friendship of all who knew him. Of his earliest years in the Navy the writer has no personal knowledge, but his work as a surveyor remains, and it was a source of great satisfaction to him to know that his labours in so many parts of the world would continue to be of use and benefit to his fellow-seamen. To give something useful to the world, something which should endure for all time, is perhaps a normal

hope of all pioneers, and an insight of the untiring efforts and application necessary to the accomplishment of a modern detailed survey is given in his book "The Chart Makers" which, humorous though it is in many places, shows how arduous is the task of the surveyor and how painstaking his investigations.

In 1889, Somerville was appointed to the Surveying Ship *Dart* and served in her and in the *Penguin* in Australasian waters until 1896; after a short period of service in the Hydrographic Department, Admiralty, he joined the *Egeria*, and in that ship he proceeded to British Columbia, carrying out surveying work in the Straits of Magellan *en route*. During the latter part of the commission he became first lieutenant, and was in 1900 appointed first lieutenant of the *Triton* in home waters. He became commander in 1901 and was next appointed to take charge of special tidal observations in the Channel Islands. In 1903, he was ordered to undertake special surveys in the Persian Gulf, for which he received the appreciation of the Lords of the Admiralty. In the early part of 1904 he was selected to take command of the *Sealark* to carry out surveys in the Mediterranean and East Indies; it was during his time in the *Sealark* that he was instructed to collaborate with the Percy Sladen Research Expedition, in the work of which he was already so interested. Returning home to England at the end of 1907, he was placed in charge of the West Coast of England Survey, and in 1912 took command of the *Research* in home waters, in which ship he was serving on the outbreak of war in 1914.

During the War, Somerville, who had been promoted to captain in 1908, was in command of H.M. Ships *Victorian*, *Amphitrite*, *King Alfred* and *Devonshire* in the 10th Cruiser Squadron. He was promoted to Rear-Admiral in 1919 and to Vice-Admiral (Retired) in 1925.

His last work in the Hydrographic Department was the compilation of "Ocean Passages of the World", and he served as chairman of a Tidal Committee in 1923.

Admiral Somerville was interested in a great variety of subjects, and whilst in the Pacific Islands collaborated with the late Commander S. C. Weigall, R.N., in compiling vocabularies of dialects of some of the Polynesian islands; he also turned his mind to the improvement of sounding appliances, and the Somerville gear, which was a great advance on older methods of sounding, is still used in the surveying service. The last years of his life were devoted to literary work chiefly connected with the South Seas, where so much of his early life was spent. In 1934, he published "Commodore Anson's Voyage into the South Seas and Round the World", in which he used his knowledge of those waters to rewrite Walter's classic, embodying at the same time the results of his researches in the Admiralty records of the period. At the time of his death he was engaged on a similar modernised version of William Mariner's "Account of the Natives of the Tonga Islands", and had already collected a considerable amount of unpublished material not known to Dr. Martin, who published the original book in 1817.

## Mr. C. A. W. Monckton

WE regret to record the death, which took place on March 1 in London at the age of sixty-three years, of Mr. C. A. W. Monckton, explorer and formerly administrative official in Papua.

Charles Arthur Whitmore Monckton was born in New Zealand in 1872 and went to New Guinea in 1895, when Sir William MacGregor was Lieutenant-Governor. In 1898 he entered the public service as resident magistrate at Samarai. The administration of the country under British rule was then in its earliest stages of organisation, and Monckton's duties were largely the pursuit of raiding parties, who constantly attacked the white miners within his jurisdiction, which covered the north-eastern area of the island, not previously administered, and of which he was the first resident magistrate. In 1903 he was also given the Northern Division, which was in a state of disorder.

In 1906, when in pursuit of previously unvisited tribes, some of whose members had raided a miners' camp and murdered some of its occupants, Monckton made the first ascent of Mount Albert Edward (13,320 ft.) under the fire of hostile bowmen, and mapped the country from it. A more strenuous expedition of the same year to the Wasia River in search of gold and to ascertain how far the river lay in British territory encountered terrible hardships and ended in disaster, for which Monckton was criticised by the authorities. In September 1906, New Guinea had come under the Australian Commonwealth; and Monckton, with characteristic impetuosity, resigned and retired to England, where he lived for the remainder of his life.

A pioneer in administration, Monckton was one of the first to recognise that the qualities which lead a native to transgress the white code by adherence to tribal custom, such as raiding and head-hunting, might be turned into useful channels. He invariably recruited his very efficient police from such criminals. He published three books in which a great gift of humour was used to advantage in displaying a keen appreciation of native character, while at the same time recording data of no little value relating to tribes at that time unknown. His first book, "Some Experiences of a New Guinea Resident Magistrate", appeared in 1920 and was received with acclamation by the critics. It was followed by "Last Days in New Guinea", published in 1922, and "New Guinea Recollections" in 1934.

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WE regret to announce the following deaths:

Mr. James Whitehead, K.C., fellow of the Imperial College of Science and Technology, who was a leading authority on Patent law, especially in its applications to technology, on April 3, aged fifty-eight years.

Dr. W. A. Parr, president of the British Astronomical Association in 1932–34, on April 2.

Prof. J. Stoklasa, director of the State Institute of Research in Plant Products, Prague, on April 4, aged seventy-six years.

# News and Views

### Sir Robert Mond: Award of Messel Medal

THE Society of Chemical Industry has awarded its Messel Medal this year to Sir Robert Mond. This medal is awarded to those who have attained eminence in applied chemistry, and is given in alternate years. Sir Robert Mond has for many years been associated with prominent concerns in the chemical industry. He is a director of the International Nickel Co., the South Staffordshire Mond Gas Co., and the Mond Staffordshire Refinery Company, Ltd., and his directorships in the past have included those of the Mond Nickel Co., and Brunner Mond and Co. Sir Robert was born in Lancashire. He is the son of the great industrial chemist Dr. Ludwig Mond, and the award of the medal will be felt by many chemists to be not only an acknowledgment of Sir Robert Mond's own services to chemical industry in Great Britain, but also a reminder of the important part taken by the Mond family in the progress of industrial chemistry in Great Britain. Dr. Ludwig Mond, Sir Robert's father, was prominent in the early organisation of the Society of Chemical Industry, having been one of its first secretaries in 1881 and its president in 1888. Sir Robert was educated at Cheltenham, Cambridge, Zurich and Edinburgh, and worked for some time with Sir William Thomson, later Lord Kelvin. He was largely responsible for the planning and equipment of the Davy Faraday Laboratory at the Royal Institution. Sir Robert is also well known for his interest in Egyptology; and he is also chairman of the Norman Lockyer Observatory Corporation. He was knighted in 1931.

### Exhibitions of Chinese Art

THE exhibition as a whole of the Eumorfopoulos Collection of objects of Chinese and Far Eastern art acquired for the nation, announced to take place in the Victoria and Albert Museum, South Kensington, will be declared open by the Chinese Ambassador on April 17. Not only will some of the pieces now be seen by the public for the first time; but also it is the last occasion on which it will be shown as a single collection. When this exhibition closes at the end of the coming summer, the exhibits will be divided between the Victoria and Albert and the British Museums, and certain of them will be allocated on loan to other museums. This exhibition will supplement the exhibition of Chinese art at the Royal Academy in several directions. The art of the Han and T'ang dynasties, for example, will be much more fully represented; and there will be an extensive series of the pottery burial figures of the Wei dynasty (A.D. 386–535). The Eumorfopoulos collection also affords opportunity for comparison, as it includes example of art from areas which did not come within the scope of the exhibition at Burlington House, such as the art of Korea, little known and not otherwise well represented in Great Britain, and the art of the nomadic tribes of southern Siberia. A charge for admission of 1*s.* will be devoted to the fund for the purchase of the collection, of which at present only one half has been raised. An exhibition of Chinese art is also being held in the City Art Gallery, Manchester. It was opened by the Chinese Ambassador on April 3 and will be on view for a period of six weeks. It consists of some of the exhibits lent to the exhibition at Burlington House by British collectors, together with specimens from collections in Lancashire and Cheshire.

### American Indians and the Land

EQUALLY with other citizens of the United States, the American Indian is benefiting under the 'New Deal'. An appropriation has been made to purchase for his benefit some of the land in Oklahoma now in the possession of the whites, which formerly belonged to Indian tribesmen. The prospects of the Indians have now much improved under the legislation promoted by the Hon. John Collier, Commissioner for Indian Affairs since 1932. He was largely responsible for the passing of the Wheeler-Howard Act in 1933, under the provisions of which an attempt is being made to promote the prosperity of the Indian on lines in accord with the tradition of tribal culture, and to revert, so far as is now possible, to the system of group tenure of land, which was broken up in the mistaken efforts of a previous generation to develop the Indian standard of life by individual grants of land. The provisions of the new legislation and its relation to existing conditions are summarised by Dr. Wilton Marion Krogman of the Western Reserve University, Cleveland, Ohio (*Z. Rassenkunde*, **3**, 1).

LAND may no longer be held in severalty by the Indian, but only through the tribe or group under the guardianship of the Federal Government, on a tenure which may vary in form. The sum of 2,000,000 dollars, together with such further sums as may accrue, has been set aside for land purchase, while a credit sum of 10,000,000 dollars has been set up, which is available for any Indian through a tribal corporation. The Indians, it is to be noted, are to be encouraged to retain their tribal culture—though not in the "back to the blanket" sense—and administration is to adapt itself to local variations in cultural pattern. It is estimated that between 1887, when they were settled on the reserve, and 1932, the Indians lost through alienation 90,000,000 acres of their grant of land. Of the remaining 47,000,000 acres one half is desert; and there are now 150,000 Indians who have no land. The popular conception that the Indian is a degenerate and disappearing race is entirely erroneous. In certain selected areas between 1905 and 1934, the Indian population rose from 61,146 to 78,139.

### Horse Mummification in Ancient Egypt

MUMMIFICATION of sacred animals is a familiar practice in the annals of Ancient Egypt, especially in the later periods. A discovery of what is thought to be the earliest known example of the mummification of a horse has recently been made on the hill of Sheikh Abdel Kurneh, on the west bank of the Nile at Thebes, by an expedition of the Metropolitan Museum of New York under the field direction of Mr. Winlock. The expedition is carrying on Mr. Winlock's excavation interrupted in 1927, when he discovered the tomb of Sen-Mut, the architect of the famous temple of Queen Hat-shepsut at Deir el-Bahari. The work of the present season, it is stated in a dispatch from Cairo in *The Times* of April 6, has brought to light the intact tombs of Ra'mose and Hatnufer, the father and mother of Sen-Mut. In clearing the bottom of the ravine preparatory to opening the rock chamber, in which the burials were found, the body of a horse was uncovered in the limestone clip. It had been mummified and wrapped and enclosed in an enormous coffin. It is of the xviiith dynasty and, therefore, probably the oldest horse burial found in Egypt up to the present. The rock chamber was crowded with funerary material, including jars and baskets containing linen, food, and in one instance a silver bowl and two small pitchers for mixing wine. Two jars are dated the seventh year of Tuthmosis III, while some of the linen and jar sealings bear titles of Hat-shepsut when she declared herself King of Egypt. On one side of the chamber were uninscribed rectangular coffins and on the other anthropoid coffins bearing inscriptions indicating that they contained the bodies of Ra'mose and Hatnufer. Neither had an official title.

### Messrs. Taylor, Taylor and Hobson, Ltd.

THE fiftieth anniversary of the foundation of the firm of Messrs. Taylor, Taylor and Hobson, Ltd., manufacturing opticians and engineers, was celebrated on Monday, April 6, by a dinner given by the directors to all employees and a few guests. The brothers Mr. Thomas Smithies Taylor and Mr. William Taylor, F.R.S., were the founders of the business in 1886. The first lenses produced by the firm were known as Rapid Rectilinear lenses. These were followed by single achromatic 'View' lenses and wide angle lenses. Mr. William Taylor at this time devoted a great deal of attention to establishing the manufacture of lenses and lens parts on an interchangeable basis, and providing means of cutting screw threads accurately. The abruptly started thread was devised and patented, and he started the practice of measuring screw threads trigonometrically with a micrometer, and with little cylinders, or wires, put between the threads, and of measuring threading tools and the amount by which they were shortened from a theoretically perfect point, by means of a notched bar. The methods were gradually developed and led to the manufacture of the engraving machine which is now well-known as the 'Taylor-Hobson Engraver'. Mr. W. Taylor has served on many standardisation committees and was responsible for establishing the principle that in gauging screw threads, the 'go' gauge must include all the elements and the 'no-go' gauges deal with them separately, except that pitch and effective diameter must be gauged concurrently. The election of Mr. W. Taylor as a fellow of the Royal Society in 1934 was a mark of recognition by British men of science of his pioneer work in the application of mechanical engineering to the manufacture of optical instruments, and the improvements of photographic lenses.

### The Aberdeenshire Dee

RIVER FLOW RECORDS, the private organisation directed by Capt. W. N. McClean, has just issued in brochure form (Parliament Mansions, London, S.W.1. 10*s*. 6*d*.) a complete account with diagrams of the observations and readings taken for the year 1935 in connexion with the survey of the River Dee (Aberdeenshire), comprising records of water-level, flow and rainfall. The diagrams, in four sheets, exhibit in coloured outline the monthly water-levels at Cairnton Gauge Post in 3-hourly averages, and the aggregate rainfall and run-off over a catchment area approximately of 528 square miles. The value of these monthly diagrams has been enhanced since their publication for 1934 by the inclusion of the maximum and minimum temperatures and wind at Balmoral and by the incidence of rainfall from the automatic rain gauge. Thus the occurrence of snow and the effect of temperature in increasing or diminishing the flow become clear in winter and spring months. The effect of wind is not obvious, and it appears likely that certain changes in water-level, which, locally, are attributed to strong down-stream winds, may be due to temperature.

ONE aim of the records is the comparison of rainfall with run-off. Daily rainfall observations were taken from ten gauges widely distributed over the area, and acknowledgments are made of the assistance rendered by the Meteorological Office at Edinburgh, the British Rainfall Organization, the Royal Meteorological Society and voluntary observers. The mean annual rainfall on the area of 528 square miles given by the British Rainfall Organization is 42 in.; the year 1935 provided 42·7 in. and 1934, 48·4 in., deduced from daily observations at the ten gauges mentioned above, combined with the mean distribution of rainfall on the area. Assessed at the end of September in each year, when the ground saturation is generally low and therefore negligible, the residual loss was 8·34 in. in 1933; 11.48 in. in 1934 and 7·36 in. in 1935. The operations of River Flow Records are extremely valuable as an aid to a national inland water survey, and the report suggests the formation of a committee of river interests, under the independent patronage of the county, to carry the Dee survey to fruition, but "the final picture would be incomplete" without the central supervision and financial support of the Government.

### Protection of Wild Life in Africa

THE Convention for the Protection of the Fauna and Flora of Africa, signed on behalf of nine Governments in London on November 8, 1933, became

effective on January 14, 1936. The ratified articles have therefore come into force in all the African territories of Great Britain, Belgium, Egypt, the Anglo-Egyptian Sudan and the Union of South Africa (Science Service, Washington, D.C.). As a result, gorilla, okapi, white rhinoceros, pigmy hippopotamus and eighteen other rare wild animals, together with the unique plant of the Kalahari Desert, *Welwitschia*, are now absolutely protected. Protection almost as complete is afforded to a series of animals in List A, which may not be killed for ordinary purposes at all, either by natives or whites, but may be taken in strictly limited numbers, with Government permission, for important scientific purposes. There are included such African elephants as possess tusks less than ten pounds in weight. If the tusks be heavier than ten pounds, the elephants fall into Class B, where they are partnered by black rhinoceros, the two species of giraffe, the wild ostrich and several kinds of egrets and hornbills. Class B animals may be hunted only by special licence, whereby the area, time and extent of the hunting is strictly limited and defined.

### British Empire Naturalists' Association

AT the annual general meeting of the British Empire Naturalists' Association to take place in the Artworkers' Guild Hall, London, on April 29, under the chairmanship of Mr. Richard Morse, the lecturer will be Mr. D. Seth-Smith, curator of birds at the London Zoological Gardens. The Council of the B.E.N.A. has recently drawn up a resolution protesting against the choice by the Air Ministry of a section of the Northumberland coast near the Farnes, frequented by many uncommon birds and including the only English breeding station of the eider duck and the only East England breeding station of the grey seal, for a future bombing station. A new local branch for Shropshire has recently been formed by the Association, and has already begun activities. It has been decided to hold the annual B.E.N.A. all-night ramble and dawn bird song record in Surrey on the night of Saturday–Sunday, May 23–24, the organisation of this being carried out by Mr. W. J. Finnigan, who has cared for the previous all-night meetings. The B.E.N.A. herbarium, for long at Bexhill, has now been transferred to the South London Botanical Institute, 323 Norwood Road, London, S.E.24, where it may be inspected daily from 2 until 9 p.m. except on Thursdays, Sundays and days of outings of the Institute.

### Electric Developments in British Ships

DURING the last three years, the shipowning and shipbuilding industries have been seriously depressed. It is satisfactory therefore to learn from a paper by Colonel A. P. Pyne (*J. Inst. Elec. Eng.*, February) that steady progress has been made in the applications of electricity in British ships. The popularity of short cruises in large luxury liners has favoured development. The problem of ventilation has attracted attention. It is now recognised that the stirring up of air by means of fans, or even the delivery of warmed or cooled air to given points by means of ducts, does not suffice. Air conditioning now takes into consideration the problems of the draughtless delivery of purified air and the extraction of vitiated air in the proper proportions. The incoming air must have the right temperature and the correct humidity to suit the climatic conditions of the moment. The air conditioning plant now changes the supply to warmed or cooled air automatically as required. The electric heating of public rooms and cabins is becoming universal. The heaters adopted are generally of the convector type, made more cheerful by luminous effects. The depression of the industry has prevented electric marine propulsion from making much progress. Two large motor-ships, the *Stirling Castle* and the *Athlone Castle*, each having a tonnage of 25,500 and auxiliary generators of 3,500 kilowatts for lighting and power, are at present being built. The *Queen Mary*, having a tonnage of 73,000, has auxiliary generators of 9,100 kilowatts capacity. The steam turbo-electric *Normandie* built in France last year has a tonnage of 75,000 and auxiliary generators for lighting and power of 13,200 kilowatts.

### New Telephoto Systems in the United States

THERE are various methods now in use in different countries for transmitting photographs, printed matter and line drawings by means of telegraph or telephone wires or by radio. In certain respects the circuits must meet more stringent requirements than those used by speech or music. The sending apparatus scans the picture in closely spaced lines and converts the light and dark portions into electric currents proportional in strength to the light and shade of the picture. The transmission along the line causes a weakening of the current, but this is got over by amplification at the receiver. In a circuit for telephotography the successive portions of the signal are spread out side by side so that all are seen by the eye at the same time. In telephoning, the ear hears them one after the other and any slight blurring is scarcely noticed. Any little irregularity in the time sequence of the signals is at once seen in the telephotograph and remains as a permanent record. In the *Bell Laboratories Record* of February, P. Mertz describes how this defect can be remedied by equalising the 'time delay' of the signals (which is done in the new Western Electric telephotograph system). For good pictures this time delay of the various rays in the transmission band must not exceed the two-thousandth part of a second. Photographs are given showing the great improvement produced by using this device on the transmission line. It is also shown how 'random noise', telegraph interference, high-frequency noise and 'echo' distort the photograph. The first of the new telephoto systems to be installed connects Miami, Washington, New York, Boston, Chicago, San Francisco, etc., and includes 7,400 miles of main circuit. In a single connexion between sender and receiver, there may be as much as 3,500 miles of cable and 2,500 miles of open wire.

### Outstanding Problems in Photometry

DR. J. W. T. WALSH gave a thoughtful address on "Outstanding Problems in Photometry" to the Illuminating Engineering Society on February 4. He pointed out that the advent of the gaseous discharge lamp has made the problem of heterochromatic photometry a very urgent one. It is well known that if two surfaces are judged to be equally bright by a number of observers with normal colour vision when the brightness is one candle per square foot, they certainly do not necessarily appear equally bright when the energy they emit is halved (Purkinje effect). Another class of photometric measurements which presents new and difficult problems is the photometry of projection apparatus, such as motor-car headlights, signal lights and similar devices. For such apparatus the conception of candle-power often becomes meaningless. The different optical elements produce beams for which the effective light centres are at such widely separated positions that there is no point that can be approximately regarded as the effective light centre of the whole. Dr. Walsh suggests two methods of attack. The first is to abandon candle-power measurements altogether and give a figure or figures for the illumination produced at a specified distance from the face of the projector. The other is to make measurements of candle-power at very great distances from the projector. In the case of a railway signal, this distance may be half a mile. This calls for the use of a telephotometer. A sensitive instrument of this type will probably in the future become part of the regular equipment of any photometric laboratory which has to deal with projection apparatus. In addition, problems arise in deciding what type of measurement is most appropriate in particular cases.

### Solar Research at the Kodaikanal Observatory

THE presidential address to the Section of Mathematics and Physics at the twenty-third Indian Science Congress was delivered by Dr. T. Royds, director of the Kodaikanal Solar Physics Observatory, who took as his subject "Some Solar Problems" (Calcutta: Asiatic Society of Bengal). Dr. Royds explained that he was dealing with topics which were the subject of present research at Kodaikanal. The first of these was the relation between the dark markings, seen on spectroheliograms, and the prominences. The motion of the dark markings near the limb demonstrates that they are situated at such a height above the photosphere that they would project 31″ above the limb, whereas the average height of prominences is known to be 36″. So far as Kodaikanal observations go, the dark markings and prominences appear to be different aspects of the same thing, that is, a narrow line of flame extending above the sun's surface, having a width of 7,000 miles, a height of 14,000 miles, and an enormous length amounting sometimes to 400,000 miles. Dr. Royds went on to deal with the problem of the support of the chromosphere: it has recently been found at Kodaikanal as the result of observations of the infra-red lines near 7770 A. that oxygen is a normal constituent of the chromosphere. This fact adds to the difficulties in the path of the theory that selective radiation pressure supports the chromosphere. Dr. Royds concluded his address by giving an account of the theory of the intensities of Fraunhofer lines and of recent measurements which have been carried out at Kodaikanal.

### Garden Allotments

UNTIL the beginning of this century, allotments were chiefly to be found in rural districts; but at the present time, largely owing to the stimulus given to the movement during the Great War, nearly four times the number are situated in urban, as compared with rural, areas. Advice on their management is frequently required, particularly by residents in towns and cities, and the publication by the Ministry of Agriculture of an illustrated bulletin (No. 90. "Allotments". London: H.M. Stationery Office, 1s.) should prove of immense practical value to all holding or contemplating holding an allotment. The scope of the bulletin is wide, and only an indication of its range can be given here. Questions of soils and their treatment, manures and manuring, with a special section on lime, are dealt with in some detail. Full directions follow for the cultivation of all the ordinary market garden crops, such as potatoes, the cabbage group, peas, beans and root vegetables and to a lesser extent fruit and flowers. Advice is also given on simple methods for purposes of protection and forcing. Only a small section is devoted to pests and diseases, as the reader is referred to the more detailed publications on the subject already issued by the Ministry. At the end of the bulletin a summary of work appropriate for each month of the year will be found, together with useful hints for those intending to exhibit their vegetables at shows. Further, the business side of allotment holding is not overlooked, and a part of the bulletin is devoted to questions of rules for allotment associations, tenancy agreements, choice, planning and layout of sites and the methods by which an individual can, where practicable, acquire an allotment.

### National Institute of Agricultural Botany

THE National Institute of Agricultural Botany has just published its sixteenth report, which records the services provided in 1935 by the Crop Improvement Branch and the Official Seed Testing Station at Cambridge and the Potato Testing Station at Ormskirk. A small quantity of the new variety of wheat 'Holdfast' was marketed during 1935. This wheat was bred from a cross between 'Yeoman' and 'White Fife', has a white chaff and white grain and shows a marked resistance to 'lodging'. It is particularly well fitted for growing on good land in high condition. The number of samples tested by the Official Seed Testing Station was 30,502, the highest on record. The work of the Potato Testing Station was seriously hampered by the abnormal weather conditions, but the usual tests of new varieties for susceptibility to wart disease were carried out, together with a number of yield and quality trials. A Lord Derby Gold Medal was awarded to 'Gladstone', a new potato produced

by Messrs. McGill and Smith Ltd. The Potato Synonym Committee has also published its findings from the trial plots laid down in 1935, and the list of varieties with their synonyms may be obtained on application. Those interested in farming and wishing to keep in touch with the current work of the Institute, one of the chief objects of which is to supply unbiased information as to germination, variety and productive value of seed, are recommended to join the fellowship of the Institute, particulars of which can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

### Soil Sterilisation

A THIRD and enlarged edition of Bulletin No. 22, "Practical Soil Sterilisation", has been issued by the Ministry of Agriculture. As in former editions, the volume deals with the practical aspects of sterilising soil by means of heat and chemicals, both on a large scale in glasshouses and in small quantities for market garden and propagation work. The process of sterilising soil by steam is now widely practised, and the recent development of a new device, the 'Hoddesdon' pipe system, which overcomes many of the disadvantages of the older methods, called for a revised issue of the bulletin. The new system is composed of pipes laid in position separately and joined prior to turning on the steam, thus enabling a more efficient distribution of the heat than was possible with the tray, grid or spike methods, where small areas tended to remain untouched. In addition, the cost, namely, £160 per acre, compares favourably with other methods, and the labour is less arduous, so that from all points of view the new system can be recommended to the commercial grower with every confidence. All practical details are supplied in the bulletin, which may be obtained from H.M. Stationery Office or any bookseller, (1s. net).

### Oxidation-Reduction Potentials

FOLLOWING on hydrogen ion concentration, the subject of oxidation-reduction potentials has opened up a new field of investigation into the character of the media in which organisms flourish. Dr. L. F. Hewitt, in his "Oxidation-Reduction Potentials in Bacteriology and Biochemistry" (L.C.C., third edition, 1935), gives a very clear presentation of the theory as well as an account of the methods of measurement. The mechanisms underlying the action of respiratory pigments as well as the characteristics of certain bacterial culture media have been very profitably examined by this technique. A good deal of information has been derived from following the oxidation-reduction potential of the medium during the actual growth of the bacteria, and the findings have been supported by other methods of investigation. As a test method for defining the optimum conditions for growth, its further possibilities may be substantial. This little book will prove of great service to bacteriologists and biologists generally.

### Osborn Library at New York

IN 1908, in the American Museum of Natural History, Prof. Henry Fairfield Osborn (see NATURE of November 16, 1935) established the Osborn Library of Vertebrate Palæontology, presenting his personal library as a nucleus. To this the Museum added such volumes as it already possessed, its file of palæontological periodicals which it has kept up to date, and continued purchasing such new volumes as its funds made possible. As in any departmental library, however, the separata are the greatest needs of the worker, Prof. Osborn continued to turn over to the Osborn Library files of those papers which he received from his colleagues. Dr. Barnum Brown, curator of fossil reptiles in the Museum, asks that those who exchanged papers with Prof. Osborn during his life should continue to keep the Osborn Library on their lists, while others are invited to send copies of their papers. It will be at once a tribute to Prof. Osborn's memory and a service to fellow-workers since the Osborn Library is open to all.

### Congress of Economic Etomology

THE annual meeting of the Deutsche Gesellschaft für Angewandte Entomologie will be held in Frankfort-on-Main on May 13–16, when three major problems in economic entomology will be discussed, namely, the control of bedbugs, mosquitoes and pests of stored products. Leaders of discussions on these problems will be Mr. A. W. McKenny Hughes, of the British Museum (Natural History) and secretary of the Medical Research Council Bedbug Committee, Prof. E. Martini, of the Institute of Maritime and Tropical Diseases, Hamburg, and Mr. E. Bernfuss, technical manager of the Städtliche Lagerhaus of Vienna. It is felt that all three problems are of international importance and urgently require attention, and it is hoped that medical officers and others concerned in public health, professional entomologists, warehouse managers, manufacturing chemists interested in insecticides, and chemical engineers interested in fumigation equipment will attend the meeting. Full particulars of the meeting can be obtained from Dr. W. Rasch, Hermann Göring Ufer 3, Frankfurt (Main) 1.

### Conference of Overseas Industrial Medical Officers

THE Annual Conference for Medical Officers in Industry Overseas will be held on July 16 at the London School of Hygiene and Tropical Medicine, in order that medical officers in industry on leave from the tropics may be able to meet their colleagues and discuss their problems. The main subject for discussion will be the prevention of disease, for example, the control of malaria and epidemic diseases in the tropics; water supplies; sewage and refuse disposal; housing; the keeping of records; and hygiene generally. Further information can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1.

**Institution of Mining and Metallurgy: Awards**

To mark the occasion of the jubilee of the Witwatersrand gold mining industry, two awards of the Gold Medal of the Institution of Mining and Metallurgy have been made, as follows: to Sir Lionel Phillips, "in recognition of his distinguished contribution to the development of the industry extending over many years; and of his public work in many capacities"; to Dr. James G. Lawn, "in recognition of his distinguished services to the mining profession and industry". The Consolidated Gold Fields of South Africa, Ltd., Gold Medal and premium of forty guineas have been awarded by the Institution to Dr. Munro S. Fisher, for his researches on the origin of alluvial gold.

**Announcements**

AT the general meeting of the Linnean Society of London held on April 2, it was announced that His Majesty the King has been graciously pleased to continue the royal patronage of the Society. The reigning Sovereign has been the patron of the Society since it received its first charter in 1802.

DR. EZER GRIFFITHS, principal assistant in the Physics Department of the National Physical Laboratory, has been elected president of the British Association of Refrigeration for the session 1936–37.

AT a meeting of the Geological Society on March 25, it was announced that the grant of the proceeds of the Daniel Pidgeon Fund for 1936 has been made to Dr. S. R. Nockolds, who proposes making a petrological study of the Garabal Hill–Glen Fyne complex, Argyll.

PROF. G. T. MORGAN, director of chemical research in the Department of Scientific and Industrial Research, will deliver the Hofmann Memorial Lecture at the Imperial College of Science and Technology on May 4, at 5.30.

MR. RICHARD K. LAW, M.P. has been appointed a member of the Medical Research Council by the Committee of Privy Council, to fill the vacancy caused by the retirement of Mr. W. S. Morrison, M.P., on becoming Financial Secretary to the Treasury.

THE Challenger Society for the Promotion of the Study of Oceanography will probably be making further grants in aid of research during the year 1936–37. The general committee is prepared to consider applications for small grants in aid of research in marine biology at a recognised laboratory during the current year. Applications, accompanied by details of the proposed research, should reach the honorary secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the middle of May.

AN extended general meeting of the British Psychological Society will be held at the University of Leeds, on April 17–20. Several papers will be read and discussed, and a symposium on "Colour Constancy" will be held with papers by Prof. David Katz, Dr. R. H. Thouless and T. M. Martin. Further information can be obtained from Dr. Ll. Wynn Jones, 7 Bideford Avenue, Leeds, 8.

THE annual malaria control course for laymen, including engineers and planters, will be held on June 22–26, at the Ross Institute of Tropical Hygiene (London School of Hygiene and Tropical Medicine), Keppel Street (Gower Street), London, W.C.1, under the direction of Sir Malcolm Watson. The course is free. Further information can be obtained from the organising secretary at the Institute.

IN view of the increasing number of the tropical agricultural problems with which the Colonial Office has now to deal, the Secretary of State for the Colonies has decided to appoint an assistant agricultural adviser in addition to his present agricultural adviser, Mr. F. A. Stockdale. Dr. H. A. Tempany, now director of agriculture in the Straits Settlements and adviser on agriculture, Malay States, has been selected for this post, and it is expected that he will take up his duties during the summer.

A VIOLENT earthquake was recorded at Kew Observatory early on April 1. The first impulse arrived at 2 hr. 23 min. 49 sec. G.M.T. The bearing of the epicentre, which was about 7,400 miles away, indicates that the shock occurred near the Philippine Islands, about lat. 6° N., long. 126° E.

DR. RUDOLF STUMMEN-TRAUMFELS, professor of zoology at Graz, has been awarded the *Linné Medal* by the Swedish Academy of Sciences.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A scientific officer for research on internal combustion engines at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendant (April 21).

Scientific officers, junior scientific officers and assistants (Grades II and III) for radio research in the Directorate of Scientific Research of the Air Ministry, The Secretary [S.2 (d)], Air Ministry, Kingsway, London, W.C.2 (April 22).

An assistant in the Department of Folk Culture and Industries, National Museum of Wales, Cardiff—The Director (April 30).

A Sorby research fellow of the Royal Society—The Assistant Secretary, Royal Society, Burlington House, London, S.W.1 (May 1).

A lecturer in mathematics and the method of teaching arithmetic in the Furzedown Training College (May 9), and a lecturer in physics and mathematics in the Avery Hill Training College (May 18)—The Education Officer, County Hall, S.E.1.

A demonstrator and assistant lecturer in chemistry in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 16).

A lecturer (woman) in geography and mathematics in St. Hild's College, Durham—The Principal (June 6).

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 622.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## New Data on Isotopes

### ISOTOPIC WEIGHTS BY THE DOUBLET METHOD

CONTINUING work with my new mass-spectrograph[1], I have made measurements of several more doublets. That of N, $CH_2$ was easy to obtain with a mixture of nitrogen and methane, and gave very consistent results. The vapour of pure heavy water did not, at first, give as strong a line at 20, $OD_2$, as was hoped, but as 19, ODH, was good, $CF_4$ was introduced and the doublet F, ODH measured. Later the intensity of $OD_2$ was improved and enabled a comparison with $^{20}$Ne to be made. The latter line was then coupled with doubly charged $^{40}$A, giving a very close doublet. By the use of $BF_3$ with a suitable quantity of neon, the fairly wide doublet $^{10}$B, $^{20}$Ne++ was photographed. The spectra also showed the expected doublet at 29 due to $^{29}$Si and $^{10}$BF. This gave the first accurate measurement of the mass of the former. The following are the results :

| Doublet | Number of doublets measured | Difference in packing fraction | Difference of mass |
|---|---|---|---|
| N, $CH_2$ | 17 | $8{\cdot}8_6 \pm 0{\cdot}05$ | 0·01245 |
| F, HDO | 10 | $9{\cdot}6_4 \pm 0{\cdot}15$ | 0·01833 |
| Ne, $D_2O$ | 14 | $15{\cdot}4_1 \pm 0{\cdot}2$ | 0·03083 |
| A++, Ne | 11 | $5{\cdot}4_4 \pm 0{\cdot}15$ | 0·01088 |
| Ne++, $^{10}$B | 14 | $16{\cdot}8_5 \pm 0{\cdot}15$ | 0·01684 |
| $^{29}$Si, $^{10}$BF | 7 | $11{\cdot}8 \pm 0{\cdot}2$ | 0·0342 |

On a plate obtained when ethane was present in the discharge, two spectra gave good measurable doublets at 27. It is quite certain that the heavier member is due to $C_2H_3$, and highly probable that the lighter is $^{27}$Al derived from the cathode. If this is so, it provides the first measurement of the mass of this simple element. What was assumed to be the doublet $^{28}$Si, CO was also measured, but the conditions were not favourable to accuracy. The following are the packing fractions and isotopic weights deduced. Those of $^{27}$Al and $^{28}$Si are only provisional.

| Symbol | Packing fraction | Isotopic weight |
|---|---|---|
| $^{10}$B | 16·1 | 10·0161 ± 0·0003 |
| $^{14}$N | 5·28 | 14·0073 ± 0·0005 |
| $^{19}$F | 2·36 | 19·0045 ± 0·0006 |
| $^{20}$Ne | − 0·70 | 19·9986 ± 0·0006 |
| $^{27}$Al | − 3·3 | 26·9909 |
| $^{28}$Si | − 5·0 | 27·9860 |
| $^{29}$Si | − 4·7 | 28·9864 ± 0·0008 |
| $^{40}$A | − 6·15 | 39·9754 ± 0·0014 |

### SOME DOUBTFUL ISOTOPES

Owing to the rapid advance in research on disintegration and the theory of nuclear structure, the existence or non-existence of rare isotopes has acquired an entirely unexpected importance and calls for a short review of the present situation.

The possible presence of lines due to compounds, particularly hydrides, has been a bugbear of mass-spectrum analysis from the start. When S 33, 34 and Ne 21 were found to be true isotopes, caution was somewhat relaxed, with regrettable results in the case of Zn and Ge. So long as ample resolution and intensity are both available, negative results are absolutely conclusive, and the spectra obtained by Bainbridge for these elements showed that many of the lines recorded by me were really hydrides. I corrected the values of abundance for this result in my book[2], and it is of interest to note that the correction brought the atomic weight of Ge into good accord with the chemical value recently confirmed by Honigschmid[3].

From the work of Dempster[4] and Bainbridge and Jordan[5] it is clear that similar corrections must be made for Cd 115, Sn 121 and Pb 209, though in the last case I find it difficult to explain line 224 on my spectra, which seemed to confirm the presence of $^{209}PbCH_3$. The following are the revised figures for percentage abundance, all the rarer isotopes of lead being regarded as doubtful.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cd mass numbers | 106 | 108 | 110 | 111 | 112 | 113 | 114 | 116 | | |
| Abundance | 1·5 | 1·0 | 15·6 | 15·2 | 22·0 | 14·7 | 24·0 | 6·0 | | |
| Sn mass numbers | 112 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 122 | 124 |
| Abundance | 1·1 | 0·8 | 0·4 | 15·5 | 9·1 | 22·5 | 9·8 | 28·5 | 5·5 | 6·8 |
| Pb mass numbers | 204 | 206 | 207 | 208 | | | | | | |
| Abundance | 1·5 | 28·3 | 20·1 | 50·1 | | | | | | |

The parabola analysis of Ni and Fe by de Gier and Zeeman[6] is, except for Ni 61, in excellent agreement with my own. Their results for Fe 58 and Ni 64, present on my plates, but of doubtful origin, makes it highly probable that these are true isotopes. The evidence as to Ni 61, where unfortunately the resolving power of the parabola apparatus is pushed to its limit, I regard as conflicting. The line 61 on my plates cannot possibly be due to a hydride of Ni and if, as is suggested, it is $C_5H$, there is the further difficulty in explaining my confirmatory line 89 $^{61}$NiCO. The matter will best be settled by the production with an instrument of ample resolving power, such as Dempster's, of a spectrum so strong that components considerably weaker than Ni 64 could be detected.

With regard to the remarkable mass-spectrum obtained by Dempster[4] with a mixture of rare earths, it appears to me probable that the lines 148, 150 are due to isotopes of Nd not recorded by the feebler beams I was able to get with anode rays. If this is so, the discrepancy between the physical and chemical atomic weight of that element may disappear.

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
March 30.

[1] NATURE, 137, 357 (February 29, 1936).
[2] "Mass-spectra and Isotopes". (Arnold, London, 1933).
[3] *Z. anorg. Chem.*, 225, 81 (1935).
[4] *Proc. Amer. Phil. Soc.*, 75, 735 (1935).
[5] St. Louis meeting, Amer. Phys. Soc., *Phys. Rev.*, 49, 416 (1936).
[6] *Proc. K. Akad. Wet. Amsterdam*, 38, 810, 959 (1935).

## Absorption of Slow Neutrons

THE absorption of slow neutrons is believed to take place in two ways: a general absorption of very slow neutrons (thermal energies) together with a highly specific absorption (rhodium, indium, silver, gold)[1] of faster neutrons. Further to investigate this phenomenon, experiments have been carried out on the absorption of neutrons with the apparatus shown in Fig. 1.

The radon beryllium source was placed in a block of lead at the bottom of a paraffin wax tube[2]. The top of the paraffin block was covered with a layer of boric acid 1½ cm. deep to absorb slow neutrons emerging from its surface. In these circumstances, the neutrons which emerge from the mouth of the tube are those which have been slowed down by repeated collisions with the paraffin wax. To detect the neutrons an ionisation chamber ½ cm. deep filled with boron trifluoride was used. Such a chamber has several advantages over a chamber lined with boron, since the kicks produced are twice as great and of uniform size, and so they are more readily distinguished from the background produced by the γ-rays emitted by the radon source. The chamber was in a shallow cylindrical box of paraffin wax 2 cm. thick; the bottom of the box could be closed with a circular sheet of wax 2 cm. thick. Such a chamber will detect neutrons over a very wide velocity range, since neutrons which are not captured on their first passage through the gas may be scattered back by the top paraffin sheet. Such a neutron will have been considerably slowed down, and is therefore likely to be detected. When the chamber is completely surrounded by paraffin wax it is not very sensitive to the slowest neutrons, since a great many of these are reflected at the first paraffin surface.

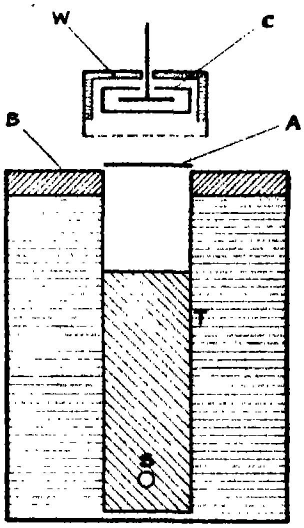


FIG. 1. *A*, absorber; *B*, layer of boric acid; *C*, ionisation chamber; *S*, source; *T*, paraffin tube; *W*, layer of paraffin wax.

One or more absorbing sheets were placed immediately over the mouth of the tube. The following results were obtained. The statistical error is about two per cent.

With the chamber surrounded by paraffin wax

| Absorber | None | B | B | B/Cd | Cd | Cd/In | Cd/Ag | Cd/Au |
|---|---|---|---|---|---|---|---|---|
| Weight in mgm./cm.². | -- | 288 | 399 | 288/159 | 159 | 159/73 | 159/220 | 159/116 |
| Number of neutrons recorded. | 100 | 58 | 53½ | 58 | 68 | 66 | 68 | 68 |

With the chamber open at the bottom

| Absorber | None | B | B/Cd | Cd | Cd/In | Cd/Ag | Cd/Au | In | Ag | Ag | Au |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight in mgm./cm.². | — | 220 | 220/159 | 159 | 159/73 | 159/200 | 159/116 | 73 | 220 | 126 | 116 |
| Number of neutrons recorded. | 100 | 17 | 13 | 23 | 20½ | 23 | 23 | 84½ | 91½ | 95 | 99 |

From these results one can estimate the width and position of the neutron absorption bands in terms of the absorption of boron. For convenience of expression, it is useful to assume that the reaction cross-section of boron is inversely proportional to the velocity of the reacting neutron. There are reasons for believing that this theory may be true[3], and even if it is not, absorption in boron will remain for some time a convenient practical method of isolating neutrons in a definite velocity range. With this notation the results obtained may be summarised as follows:

The absorption band of cadmium occurs in the energy range[4] 0–1½ e.v. and the results are consistent with a very narrow absorption band (0–0·1 e.v.). The absorption band of indium occurs in the same range and partly overlaps that of cadmium. No effect due to the specific absorption of gold or silver could be found, and it is therefore probably not in the range investigated.

This method of measurement is being extended to other elements and other velocities.

C. H. COLLIE.

Clarendon Laboratory,
Oxford.
March 5.

[1] Amaldi and Fermi, *Ric. Scient.*, 6, 2, 9 (1935); Szilard, NATURE, 136, 950 (1935); Frisch, Hevesy and M'Kay, NATURE, 137, 149 (1936).
[2] Hopwood and Chalmers, NATURE, 135, 341 (1935).
[3] Bohr, NATURE, 137, 344 (1936).
[4] Frisch and Placzek, NATURE, 137, 357 (1936).

## Conservation of Energy and Momentum in Atomic Processes

ACCORDING to recent experiments by R. Shankland[1], the conservation principles are not obeyed in individual processes of interaction between matter and radiation. The general theoretical implications of the new results have been considered by Dirac[2], who concludes that they only require us to forgo quantum electrodynamics (in which radiation is represented in terms of light-quanta rather than in

terms of electromagnetic waves). In this note I wish to direct attention to one or two points which may be of interest in connexion with the new results and the Uncertainty Principle.

Let us consider the γ-ray microscope for locating an electron. Let the electron be illuminated by radiation the total intensity of which is such that the average energy of the radiation scattered by the electron is a fraction $p$ of $h\nu$. The fraction of such experiments in which an electron recoils is then $p$, and the fraction in which a scintillation is observed in the focal plane of the lens is also of the order of $p$. On the theory of strict conservation, the recoils and scintillations happen in the same experiments (coincidences), so that the location of the electron is inevitably accompanied by a disturbance of its momentum. This, however, is not so if the new results of Shankland are correct (assuming with Dirac that they mean that there is no coincidence in time between the 'scattering' by, and the recoil of, an electron), and in an experiment in which a scintillation is observed the probability that the electron has recoiled is no more than in an experiment in which a scintillation is not observed—it is equal to $p$ in both cases. It would thus appear that by making $p$ small we could in those experiments in which a scintillation *is* observed deduce the position of the electron, and at the same time be sure that its momentum has not been disturbed. The new results would thus run counter to Heisenberg's Uncertainty Principle.

The smallness of $p$ is essential to the above argument. To be fairly sure of a result in a given experiment $p$ must, of course, be of the order of unity. Under such conditions the electron is fairly certain to recoil, and we again have uncertainty in momentum—in fact, a greater uncertainty than in Heisenberg's γ-ray microscope because we have no information about the direction of recoil.

As the results of earlier work are not in accordance with those obtained by Shankland, it is desirable that further information be obtained regarding the conservation of energy and momentum in individual quantum processes. With this object in view I have experiments in progress on the emission of radiation by single atoms. In these experiments Wilson-cloud observations are made on the absorption of the fluorescent radiation from argon atoms, in order to see if this radiation is only emitted by those atoms which have not suffered internal conversion, as would be the case if there is strict conservation.

*Note added in proof.*—Regarding the argument in the second paragraph the following supposition is involved: If it is certain that a scattered radiation field has originated within a certain volume $\delta v$, and nowhere else, then there must have been a scattering particle in that volume at the time concerned.

E. J. WILLIAMS.

Physical Laboratories,
Manchester University.
March 6.

[1] R. Shankland, *Phys. Rev.*, 48, 8 (1936).
[2] P. A. M. Dirac, NATURE, 137, 298 (1936).

## Apparatus for the Investigation of the Ionosphere

IN a previous communication[1] a semi-automatic method was described by which curves showing the equivalent height of the reflecting regions of the ionosphere as a function of the frequency of the exploring radio waves could be plotted. In order to increase the flexibility of the method, a new system of electrical linkage between the tuning systems at the transmitter and at the receiver has been developed whereby the receiving installation automatically follows the changes of the sender frequency, so that the two stations maintain synchronism without attention.

The high-frequency circuits of the receiver which must be kept in tune with the frequency of the exploring waves are tuned by a single control. The receiver, which is of the superheterodyne type, has an intermediate amplifier tuned to 110 kc. per sec. The signal from the transmitter and part of the output from the high-frequency oscillator of the receiver are coupled to a valve $V_1$ used as a first detector. The signal frequency after $V_1$ will therefore be the difference between the frequency transmitted and the frequency to which the high-frequency oscillator at the receiver is tuned. This new frequency passes through the primary winding of a transformer to two other valves $V_2$ and $V_3$, which are also used as detectors. The secondary of this transformer has two windings, one of which is tuned to resonate at 100 kc. per sec. and is associated with $V_2$, and the other is tuned to resonate at a frequency of 120 kc. per sec. and is associated with $V_3$. The output from $V_2$ and $V_3$ passes through a differential relay. When the transmitter and receiver are in tune, the difference in the current flowing through the two windings of the relay will be zero. Immediately the tuning of the receiver varies with respect to the transmitter, the amplitude of the signal impressed on the grid of $V_2$ or $V_3$ will be increased according as the frequency to which the receiver is tuned increases or decreases with respect to the tuning of the receiver. The change in anode current caused by this signal operates the relay, which is used to control a shaded pole reversible A.C. motor. This motor is coupled to the tuning control of the receiver, which is thereby caused to

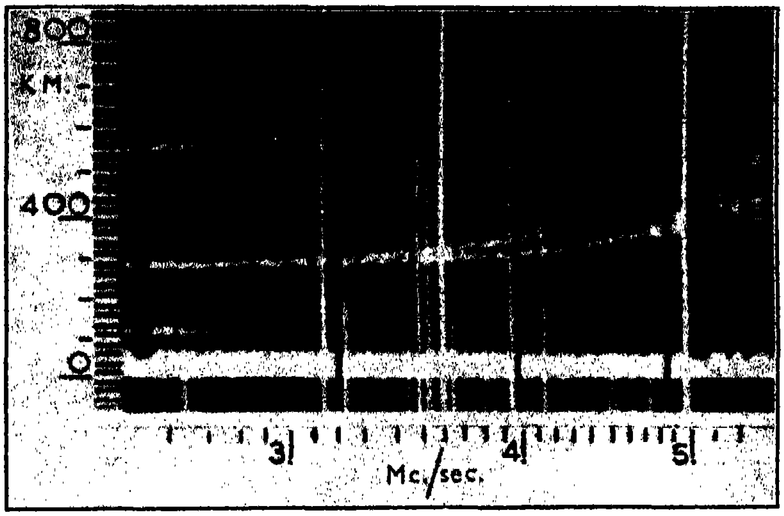


FIG. 1. Curves showing the relation between the equivalent height of the reflecting regions of the ionosphere and the frequency on which the exploring radio waves are emitted.

rotate until the high-frequency oscillator is again tuned to 110 kc. per sec. below the frequency of the transmitted signal (that is, when the difference in current through the relay windings is again zero).

Fig. 1 shows a curve of the type referred to above. The frequency on which the exploring waves are sent out is increased continuously from 2·7 to 5·2 mc. per sec. The broad white trace near the bottom of the picture is due to the ground pulse. At the lower frequencies reflection has taken place both from the *E* and *F* regions. Magneto-ionic splitting and the critical frequency for the ordinary ray from region *F* are also shown. The appearance of a saw tooth effect on the upper edge of the ground pulse trace shows the 'hunting' of the receiver tuning. The light vertical lines shown in the picture are due to interfering stations.

One of the difficulties in applying this system is the small amount of energy available for control purposes. The duration of the emission, which is repeated fifty times per second, is only $10^{-4}$ sec. The energy is therefore less than 1/200 of that of a continuous emission of the same power. It is essential that the energy from the wanted transmitter should be great in comparison with that from all others.

This may be achieved in two ways: (1) by causing the energy to be passed from transmitter to synchronising system by means of a transmission line; (2) by arranging that the valve $V_1$ in the synchronising system is only sensitive for the duration of the wanted emission. The second arrangement makes it possible to link a receiver with a transmitter even in the absence of a ground ray.

This work was carried out at the Radio Research Station, Slough, as part of the programme of work of the Radio Research Board.

R. NAISMITH.

Radio Department,
National Physical Laboratory.
Feb. 17.

[1] NATURE, 133, 66 (1934).

## Geomagnetic Effect on Cosmic Radiation in the Stratosphere

As shown in a previous note[1], the geomagnetic effect on cosmic radiation seems to begin at the same latitude (about 50°) independently of the altitude. We concluded, therefore, that it would be interesting to compare the latitude effect of all our ionisation measurements, made during the two last ascents of the *F.N.R.S.* (1932–34), without taking the altitude into account.

For this purpose, we have plotted against the geomagnetic latitude $\lambda$, the ratio between the ionisation $J_\lambda$ measured at $\lambda$ degrees, and the ionisation $J_{50°}$ measured at 50° at the same altitude (Fig. 1).

Each point in Fig. 1 being the mean value of a series of measurements, the rectangles give the probable error calculated from the dispersion of individual measurements. The measurements include those already used in our previous note and also those made with the high-pressure ionisation chamber. All the measurements were performed at altitudes corresponding to pressures of the atmosphere between 70 mm. and 180 mm. Hg.

It can be seen that the magnetic effect is practically the same at all altitudes, the dispersion of experimental points being less than the probable error. The critical geomagnetic latitude is about 49°, the same as at sea-level. For $\lambda$ less than 49°, the decreasing rate is of the order of 7 per cent per degree.

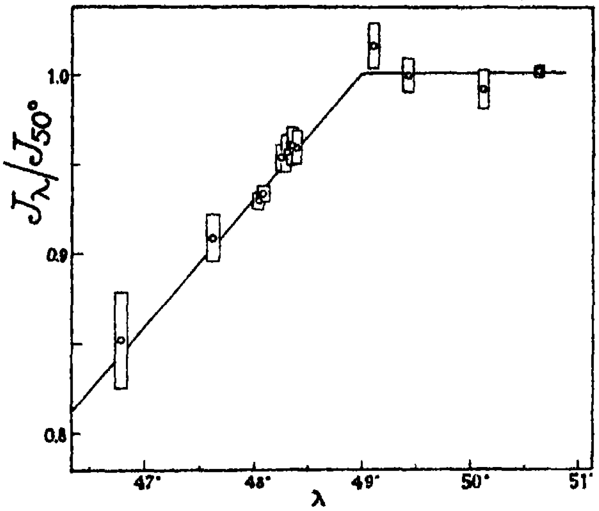


FIG. 1.

This result seems to be in contradiction with the hypothesis that the lack of magnetically soft components in the cosmic radiation at sea-level is only due to atmospheric absorption.

MAX G. E. COSYNS.

Physical Laboratory,
"Fondation Medicale Reine Elisabeth",
Brussels.
March 3.

[1] NATURE, 135, 313 (1935).

## Diffraction of X-Rays by Bence-Jones Protein

FOLLOWING the discovery by Bernal and Crowfoot[1] of the sharp diffraction spectra obtained from single pepsin crystals, Wyckoff and Corey[2] showed that with suitable technique certain other microcrystalline proteins (for example, oxyhæmoglobin) give diagrams with spacings between 10 A. and 40 A.

FIG. 1. Crystal of Bence-Jones protein. × about 225.

We had at our disposal a sample of crystallised Bence-Jones protein obtained by precipitating three times with ammonium sulphate, dialysing against distilled water and concentrating in the cold; the crystals spontaneously precipitated from the aqueous solution were dissolved in a little sodium chloride or urea solution and reprecipitated by dialysis, etc. The largest single crystals were 150 μ long and 15–60 μ

wide. They were described by Dr. Seiffert as slender, occasionally compressed, hexagonal pillars with a rhombohedron (Fig. 1). A more detailed description will appear elsewhere. The instability of the crystalline structure is very marked, and the crystals are best kept in the mother liquor in a refrigerator.

The suspension was sent from Berlin to Geneva and kept at 5° C. Prior to exposure, the specimen was placed in a thin glass tube (*Markröhrchen*) and this was sealed with wax at both ends. This was necessary because otherwise evaporation takes place during the exposure and the lattice is destroyed. As in the case of the crystalline substances described by Bernal and Wyckoff, water of crystallisation is necessary for the production of an interference pattern by this protein. Exposures were made with copper $K\alpha$-radiation, 15 m.a., 35 kv., at distances up to 77 mm. The temperature was always below 12° C.; duration of exposure 10–40 hours; pin-hole collimator 0·7 mm., 80 mm. long. The lines are nevertheless relatively weak.

| Number | Spacing (A.) | Intensity |
|---|---|---|
| 1 | 41 | very strong |
| 2 | 28 | medium |
| 3 | 25 | weak |
| 4 | 14·8 | weak |
| 5 | 11·1 | medium |
| 6 | 10·1 | medium |
| 7 | 4·8 | medium (diffuse) |
| 8 | 3·4 | strong (diffuse |
| 9 | 2·2 | weak (diffuse |

The spacings and intensities are similar to those obtained by Wyckoff and Corey for oxyhæmoglobin. From the great separation of the planes, it follows that the unit cell is large and accordingly should contain at least one 'chemical' molecule of protein. The molecular weight of Bence-Jones protein as determined by Svedberg is about 34,000.

A. MAGNUS-LEVY.
KURT H. MEYER.
W. LOTMAR.

Berlin and Geneva.
Feb. 3.

[1] NATURE, 133, 794 (1934).
[2] *Science*, 81, 365 (1935).

## Positive Platinum Sols

A DETAILED investigation on the adsorptive properties and the capacity of platinum electrodes, made by A. Frumkin and A. Šlygin[1], has led to the conclusion that there may exist, besides the negative platinum sol with oxides on the surface of the particles, which has been described by Pennycuick, two further varieties of platinum sols. One of them should be a negative sol, with its surface coated with a film of adsorbed hydrogen, the outer part of the double layer consisting of cations. The other should be a positive sol with a double layer, the outer part of which is formed by anions. According to the results obtained with platinum electrodes, it was expected that positive sols would be obtained by a careful oxidation of negative $H_2$-platinum sols. These positive sols must themselves be transformed by further oxidation into the usual negative sols. These conclusions were announced by A. Frumkin at the discussion on "Colloidal Electrolytes" held by the Faraday Society in September 1934[2]; it remained uncertain, however, whether the stability of positive platinum sols, which is determined mainly by an electrical double layer, is such that it would be possible to prepare them.

We had prepared and investigated[3] negative $H_2$-platinum sols, and we have now succeeded in preparing positive platinum sols by a very slow and careful oxidation of negative $H_2$-platinum sols. The experimental procedure was based on a control of the degree of oxidation of the platinum surface by measurement of the conductance of the sol. On adding a small amount of hydrochloric acid to a $H_2$-platinum sol, there is a rise of conductance of the sol, corresponding to the amount of acid added, as no acid is adsorbed. During the bubbling of oxygen highly diluted with nitrogen through the sol, there is a continuous change of conductance, due to adsorption of acid, followed by its partial desorption when the surface begins to be covered with an oxide film. Each point of the curve corresponds to a definite state of the surface. Stopping the further oxidation at a definite point by saturating the sol with pure nitrogen, and transferring the sol to an apparatus for cataphoretic measurements in an atmosphere of pure nitrogen, we have been able to measure the cataphoretic velocity of sols corresponding to different degrees of oxidation, made all from the same initial batch of $H_2$-platinum sol. The following data are typical of the results obtained:

| | Initial $H_2$-Pt-sol | During progressive oxidation | | | |
|---|---|---|---|---|---|
| Cataphoretic mobility ($\mu$/sec. per v./cm.). | − 2·4 | + 1·7 | + 3·3 | − 2 | − 2·3 |

The negative charge of the last portions of sol corresponds to the state of the surface when acid is partly desorbed, which is accounted for by the formation of an oxide film.

The same effects can be obtained with sulphuric acid instead of hydrochloric, but the sol is much more unstable. It is not yet possible to say whether these positive platinum sols can exist for a considerable length of time.

These results show that the particles of a platinum sol behave like small platinum gas electrodes. The existence of positive platinum sols clears up to some extent the contradiction which hitherto existed between data on the sign of the charge of metallic surfaces as deduced from electrokinetic measurements and from electrode potentials.

NATHALIE BACH.
N. BALASCHOWA.

Laboratory of Surface Phenomena,
Karpov Chemical Institute,
Moscow.
Feb. 1 ).

[1] *Sow. Phys.*, 4, 239 (1933); *C.R. Acad. Sci. U.R.S.S.*, 2, 176 (1934); *Acta Phys. Chim. U.R.S.S.*, 3, 791 (1935).
[2] *Trans. Farad. Soc.*, 3, 69 (1935).
[3] *Acta Phys. Chim. U.R.S.S.*, 3, 79 (1935).

## The Hydroxyl Bond in *n*-Aliphatic Alcohols

ROBERTSON[1], in an interesting note to NATURE, recently pointed out the probable existence of the Bernal-Megaw 'hydroxyl bond'[2] in resorcinol. Further evidence of the existence of such a bond is to be found in a previous paper by E. Ott and the author[3] on the X-ray study of the *n*-aliphatic alcohols. It was found that in the $\alpha$-modification ($\gamma = 90°$) the distance between hydroxyl groups projected on the *c*-axis is 1·46 A. If a close packing of the hydroxyl heads is assumed, the centres of the OH groups are then found to be separated by a distance of 3·13 A. The value of $a_0 = 4·76$ A. given by Bernal[4] is used in this calculation. The distance 3·13 A. is less than

the ordinary approach between aliphatic chains, and compares favourably with the examples given by Bernal and Megaw in their discussion of the 'hydroxyl bond'.

As a conclusion drawn from this calculation, one is forced to question the space group determination of Bernal[4]. He has suggested the space group $C_{3m}$ for the $\alpha$-modification of $C_{12}H_{25}OH$. The two molecules per unit cell are then placed in the equivalent positions $00u$ and $00\bar{u}$. This puts the two molecules on a single triad axis, and does not allow for close packing of the hydroxyl groups. Assuming the tetrahedral angle for the carbon-oxygen bond, then on the basis of this space group determination and the projected OH – OH distance of 1·46 A., the distance between hydroxyl centres is calculated as 2·09 A. This distance is much too small to be reasonable for the 'hydroxyl bond'. Perhaps the intensity data of Bernal could be interpreted to give a different space group which would allow for a close packing of the hydroxyl heads.

The calculation of the projected OH – OH distance made by E. Ott and the author is to be seriously considered, because it is based upon 001 reflections from the $\alpha$-modifications of six members in the series of *n*-aliphatic alcohols $C_{12}H_{27}OH$ to $C_{18}H_{37}OH$, all of which agree.

DONALD A. WILSON.

Chemistry Department,
Stanford University,
California.
Jan. 29.

[1] NATURE, 136, 755 (1935).
[2] *Proc. Roy. Soc.*, A, 151, 384 (1935).
[3] *J. Chem. Phys.*, 2, 239 (1934).
[4] *Z. Krist.*, 83, 153 (1932).

## Effect of Ascorbic Acid and Indolyl Acetic Acid on Regeneration of Willow Branches and Germination

IN the middle of 1935 we began an investigation into the effect of vitamin C on plants, and the general growth response since claimed by Synnöve v. Hausen[1] was obtained by us with tomato and castor oil plants.

β-Indolyl acetic acid was synthesised after the method of R. Majima and T. Hoshino[2], and the related indole derivatives β-indolyl propionic acid, β-indolyl methyl malonic acid (which yields β-indolyl propionic acid by loss of carbon dioxide) and β-ethyl indole were synthesised in a manner which precluded any possible contamination with β-indolyl acetic acid. Epinastic curvatures were obtained on a large range of plants with β-indolyl propionic acid, which however gave no positive result with the oat test, so that Thimann and Koepfli[3] were mistaken in attributing positive results to persistent traces of the lower homologue.

A selected range of willow branches, 12 inches long, was placed in vaseline-sealed glass containers with the morphologically lower ends in 200 c.c. of Pfeffer's[4] inorganic nutrient solution containing the compounds mentioned. At a concentration of 1 in 100,000, the order in which both roots and shoots appeared was the following: (1) ascorbic acid, (2) β-indolyl acetic acid, (3) β-indolyl propionic acid, (4) control. With a concentration of 1 in 500,000, the result was: (1) ascorbic acid, (2) control, etc. Evidently the stimulatory action of the ascorbic acid persists even in very low concentration in spite of probable oxidation. With a high concentration of 1 in 2,500, regeneration is retarded considerably by the ascorbic acid, and almost entirely prevented by the indole derivatives.

Oats, mustard and cress seeds were germinated under sterile conditions in 10 c.c. of Pfeffer solution containing the compounds. At a concentration of 1 in 10,000, both germination and subsequent growth occurred in the following order: (1) ascorbic acid, (2) control, (3) β-indolyl propionic acid, (4) β-indolyl acetic acid. When applied after germination, and following upon a certain amount of root development, the β-indolyl acetic acid took third place. Abnormal length of coleoptiles and hypocotyls occurred with the indole compounds in the case of prostrate seedlings. The indole derivatives at this concentration apparently retard germination and growth, and even at lower concentrations (1/100,000) the result is the same, though ascorbic acid still acts in stimulatory fashion. With higher concentration (1/1,000) the ascorbic acid also showed a retarding effect, while the others were practically lethal.

The effect of the ascorbic acid agrees with the recently published result of Havas[5], and points to the familiar hyper-effect of the vitamins; but the retarding effect of the indole derivatives seems in main part due to the prevention of root growth, which occurred very strikingly in those cases. In high concentration the roots grown in β-indolyl acetic and β-indolyl propionic acids were short and cone-shaped with swollen bases, F. A. F. C. Went's[6] suggestion of transverse growth in the root caused by the auxins seeming to be verified. The abnormal length of the stems of prostrate seedlings was probably due to direct contact with the growth compounds.

W. DAVIES.
G. A. ATKINS.
P. C. B. HUDSON.

Chemistry and Botany Departments,
University of Melbourne.
Feb. 17.

[1] Synnöve v. Hausen, NATURE, 136, 516 (1935).
[2] R. Majima and T. Hoshino, *Ber.*, 58, 2043 (1925).
[3] K. V. Thimann and J. B. Koepfli, NATURE, 135, 101 (1935).
[4] Pfeffer; see Knudson, *Bot. Gaz.*, 73, 1-25 (1922).
[5] L. Havas, NATURE, 136, 435 (1935).
[6] F. A. F. C. Went, *Biol. Rev.*, 10, 2 (1935).

## Ascorbic Acid as a Precursor of Serum Complement

PARTICULARLY in septicæmic conditions affecting man, the importance of "alexine" (Bordet) or "complement" (Ehrlich) in immune processes, although (so far) inexactly defined in scope, is becoming very generally recognised[1,2]. Frequent attempts to analyse and define this substance, generally by chemical means, have resulted in the recognition of at least four components or "end" and "middle-pieces"[3,4].

I have recently obtained evidence (to be published in detail elsewhere, pending the permission of the Anglo-Iranian Oil Co., Ltd.) that the "complement" complex, as it exists in the circulating blood of the guinea pig, following coagulation and separation of serum, and in the form demonstrable by a standardised hæmolytic system, disappears or suffers reduction in titre, when ascorbic acid is withdrawn, completely or partially, from the food of the experimental animal; and the concentration of "complement" (obtained in the same manner) can be restored to normal, or slightly supernormal, level by the consumption of a diet rich in vitamin C.

These effects can be produced in seven days or less, too soon for qualitative malnutrition to affect the animal's physical well-being; indeed it remains in perfect health, being supplied with everything necessary for healthy functioning, except, during a few days only, ascorbic acid. It follows that reduction or disappearance of "complement" from the circulating blood must be one of the earliest signs (in guinea pigs, and perhaps in man) of a state of affairs which, if prolonged for twenty to forty days (in the cavy) or four to eight months (in man) will result in scurvy.

FRANK MARSH.

Pathological Laboratory,
c/o Anglo-Iranian Oil Co., Ltd.,
Masjid-i-Sulaiman,
Via Ahwaz, South Iran.
Feb. 8.

[1] Cadham, F., "Septicaemia: a Method of Treatment", *Amer. J. Med. Sci.*, **188**, 542 (1934).
[2] Whitby, L. E. H., and Britton, C. J. C., "Disorders of the Blood", 45 (J. and A. Churchill, London, 1935).
[3] Gordon, J., and Wormall, A., "The Action of Ultra-Violet Rays on Complement", *Biochem. J.*, **22** (4), 909 (1928).
[4] Gordon, J., and Thompson, F. C., "The Relationship between the Complement and Opsonin of Normal Serum", *Brit. J. Exp. Path.*, **16** (1), 101 (1935).

## A Satisfactory Substitute for the Osmium Tetroxide Golgi Apparatus Methods

OSMIUM tetroxide at 18*s*. a gram is the most expensive substance used in biological research. It is principally used in the Kolatchew and Weigl methods for the Golgi apparatus, and in the F. W. A. and Champy methods for mitochondria. The nearest cheap substitutes for Weigl and Kolatchew methods are the formalin-silver methods of Cajal and Da Fano. The trouble with these latter methods is that there is usually distortion and often incrustation of the Golgi bodies, banana-shaped elements, for example, often becoming beads, or spheres, and different from what can be seen *intra vitam*. The general fixation is often very poor.

I have been astonished at the beauty of silver nitrate formalin preparations made according to F. Aoyama's modification of Cajal's method[1]. This method is as follows: Fix small pieces of tissue in cadmium chloride 1 part, formol neutral 15 parts, distilled water 85 parts, for three to four hours. Rinse quickly in two changes of distilled water, and transfer to 1·5 per cent solution of silver nitrate for 10 to 15 hours at 22° C. Rinse quickly in two changes of distilled water, preferably in a darkened room, and transfer for 5 to 10 hours to the reducing solution (hydroquinone 1 part, neutral formol 15 parts, distilled water 85 parts, 0·1 to 0·15 parts of sodium sulphite, sufficient to produce yellowish tinge). Wash thoroughly in tap water ($\frac{1}{2}$ to $\frac{3}{4}$ of an hour), upgrade, imbed and section. Counterstain in carmine or hæmatoxylin and eosin. Cold-blooded animals may need longer impregnation and fixation.

This method has been tried in this laboratory on the following material: rat pancreas and dorsal root ganglion, *Helix* ovotestis and cerebral ganglion, midgut of mealworm. In every case the preparations were superior to those got by Da Fano's method, and very nearly approached the *best* Weigl preparations for morphology of Golgi bodies. The non-cellular elements of tissues were bright yellow, and quite different from the Cajal or Da Fano effect. The rat and snail preparations were perfect enough for the most precise research on cell inclusions. In only a few cases did mitochondria impregnate, and the method is probably more specific than Weigl, and much more specific than Da Fano.

The preparations were made by Mr. R. Brown and Miss M. Daniels. The formalin used was unneutralised, but from a fresh supply; the silvering was done in a Hearson incubator at the proper temperature.

J. BRONTË GATENBY.

Trinity College,
Dublin.
Feb. 24.

[1] *Z. wiss. Mikr.*, (1930).

## Induction of Mammary Ducts

THE mammary gland of the pig has normally two primary ducts which open separately on the surface of the nipple. Embryologically, the two ducts proliferate from the base of a cone-shaped depression of the stratum germinativum known as the mammary pocket or mammary bud. A similar depression or epithelial ingrowth, variable in depth, surrounds the nipple at its juncture with the body wall. Among several fœtal glands sectioned, a few cases of aberrant ducts, similar histologically to the primary ducts, were noticed to have sprouted from the same relative position to the apex of the epithelial ingrowth at the base of the nipple as the primary ducts do to the apex of the mammary pocket (Fig. 1).

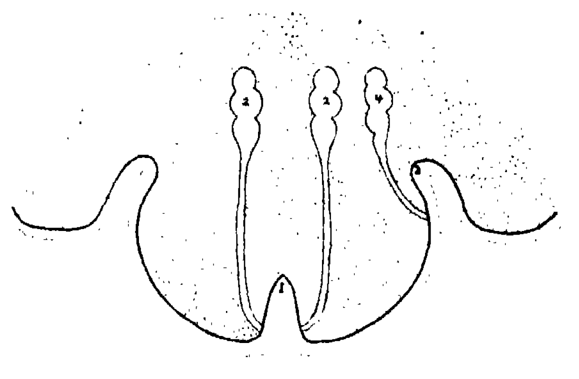


FIG. 1. Diagrammatic section through the nipple of a fœtal pig. (1) Mammary pocket; (2) primary ducts; (3) epithelial ingrowth; (4) aberrant duct.

These aberrant ducts would appear to furnish evidence that an inducing stimulus is responsible for the development of the primary ducts, similar in principle to Spemann's demonstration[1] of the underlying mesoderm providing an inducing stimulus for neural plate development in Urodela. Recently, Waddington[2] suggested that some, if not all, inductions are due to the diffusion of active chemical substances into the reacting tissues. It would appear reasonable therefore to infer that an active substance is present in the nipple which stimulates duct development in specific locations relative to apices of epithelial ingrowths. Furthermore, that the stimulus is specific for particular groups of animals. Thus in the horse, in common with the pig, there are normally two primary ducts which develop respectively from the anterior and posterior walls of the mammary pocket; ruminants have only one duct, which proliferates from the apex of the mammary pocket, and in man there are several primary ducts.

Phylogenetically, Darwin considered the mammary glands to have developed in response to an intimate relationship existing between mother and offspring as occurs in the lower mammals. Histologically, they have been regarded as both modified sweat and sebaceous glands. Bresslau[3] regards the increased secretory activity of skin glands on particular spots of the abdomen in the lower mammals as due to the presence of highly vascular gland areas. He considers the gland areas to be phylogenetically older than the Mammalia, since they are found on the ventral surface of some birds—the so-called brooding spots. In the higher mammals the mammary glands from their inception are specialised structures the ducts of which, as previously mentioned, appear to owe their inception to an inducing substance; the occasional absence of this substance may be the cause of the blind teats sometimes found.

ALAN DEAKIN.

Central Experimental Farm,
Ottawa.
Feb. 6.

[1] *Arch. Entw. Mech. Org.*, **100**, 599.
[2] *J. Exp. Biol.*, **13**, 86.
[3] "The Mammary Apparatus of the Mammalia" (Methuen).

## Dissociation Energies of CO and CN, and Heat of Sublimation of Carbon

THERE has recently been in this journal some discussion on the heat of dissociation of carbon monoxide[1]. In the most recent communication, Brons[1] states that the value for $D_{CO}$ is definitely 8·41 volts = 193·9 kcal. It is the object of this letter to point out that the value given by Brons is not absolutely definite, and that there is still another possible value for this quantity, which up to now cannot definitely be excluded and is perhaps even more probable than the value given by Brons.

By a well-known procedure, the heat of sublimation $L$ of carbon may be derived immediately from the heat of dissociation of CO, the heat of combustion of solid carbon to CO (26·4 kcal.) and the heat of dissociation of oxygen (116·4 kcal.). The value obtained with Brons' $D_{CO}$ is $L$ = 109·3 kcal., whereas the value obtained from thermal data (vapour pressure curve of carbon) is $L$ = 143 kcal. This discrepancy, as was pointed out to me some time ago by Prof. P. Harteck, seems to be rather too large, and one is tempted to look for a loophole in the proof given by Brons.

Actually the value given by Brons is obtained from a new predissociation limit, 9·66 volts above the ground state of CO. The difference in energy of this limit from the limit found at 11·05 volts is just equal to the difference in energy of the $^1S$ and $^1D$ states in the carbon atom. The agreement is in fact rather close. However, as I have already pointed out on several occasions[2], the actual dissociation limit may lie *more or less below* the predissociation limit, except in the cases where a breaking off of the rotational fine structure is observed for at least *two* successive vibrational levels. The latter is the case for the 11·05 volts limit in CO, and this limit is therefore a real dissociation limit; whereas for the new predissociation limit the breaking off has been observed for only *one* vibrational level, and therefore the value 9·66 is up to now only an upper limit to the corresponding dissociation limit, which in fact may be appreciably lower. Therefore the products of dissociation at the upper dissociation limit (11·05 volts) need not necessarily be $C(^1S) + O(^3P)$, as concluded by Brons, but may also be $C(^3P) + O(^1D)$, assuming that the above-mentioned agreement is a chance coincidence. On this assumption, it follows that the *heat of dissociation of CO* is

$$D_{CO} = 73{,}760 \text{ cm.}^{-1} = 9\cdot093 \text{ volts} = 209\cdot7 \text{ kcal.}$$

The lower point of predissociation newly found by Brons would then correspond to a dissociation into normal atoms ($C(^3P) + O(^3P)$) with 0·57 volts of excess kinetic energy. The comparatively large amount of excess kinetic energy is not unusual; for example, the predissociation of CO found by Schmid and Gerö[3] 0·48 volts above the 11·05 limit definitely leads to the same dissociation products as the 11·05 limit itself, that is, the atoms in this case have an excess kinetic energy of 0·48 volts. (This follows from the fact that the difference of the two predissociation limits, 0·48 volts, is definitely smaller than any plausible energy difference of the separated atoms.)

Our conclusion is therefore that, besides the value $D_{CO}$ = 8·41 volts = 193·9 kcal. given by Brons, the value $D_{CO}$ = 9·093 volts = 209·7 kcal. is also compatible with the predissociation data of CO now available. The latter value has the advantage that it does not lead to so low a value for the heat of sublimation of carbon. The value yielded is now $L$ = 125·1 kcal. instead of 109·3 kcal. (Incidentally, it may be remarked that the value of $L$ obtained from $D_{CO}$ is the heat of sublimation into normal atoms, not into molecules or a mixture of both, as the thermal value 143 kcal. (cf. above) probably is.) Furthermore, the *heat of dissociation of the CN molecule* into normal atoms obtained from the heat of sublimation of carbon, the heats of combustion of $(CN)_2$[4] and of carbon, the dissociation energy of $N_2$ and that of $(CN)_2$ into two CN[5] turns out to be 5·45 volts = 125·5 kcal. on the assumption of Brons. This is also improbably low, whereas the value $D_{CO}$ = 9·093 volts leads to $D_{CN}$ = 6·17 volts = 142·4 kcal., which seems more probable.

| | | Brons | Herzberg |
|---|---|---|---|
| $D_{CO}$ | kcal.<br>volts | 193·9<br>8·41 | 209·7<br>9·093 |
| $L$ | kcal. | 109·3 | 125·1 |
| $D_{CN}$ | kcal.<br>volts | 124·6<br>5·40 | 142·4<br>6·17 |

The two alternative sets of values are compared in the table above. A final decision between the two may only be obtained if more data on the predissociation of CO or CN, or on the heat of sublimation of carbon, are available. It may, however, be stressed that the accuracy of each set is rather high.

G. HERZBERG.

Department of Physics,
University of Saskatchewan,
Saskatoon, Sask.
Jan. 3.

[1] P. Goldfinger and W. Lasareff; B. Rosen, NATURE, **136**, 1077 (1935); H. Lessheim and R. Samuel, NATURE, **136**, 606 (1935); P. Brons, NATURE, **136**, 796 (1935).
[2] G. Herzberg, *Ann. Physik*, **15**, 677 (1932); G. Herzberg and H. Sponer, *Z. phys. Chem.*, B, **26**, 1 (1934); G. Büttenbender and G. Herzberg, *Ann. Physik*, **21**, 577 (1935).
[3] R. Schmid and L. Gerö, *Z. Phys.*, **96**, 546 (1935).
[4] J. McMorris and R. M. Badger, *J. Amer. Chem. Soc.*, **55**, 1952 (1933).
[5] G. B. Kistiakowsky and H. Gershinowitz, *J. Chem. Phys.*, **1**, 432 (1933).

## Axial Rotation of Globular Star Clusters

THE axial rotation of globular star clusters has not yet been measured, so far as we know, from the differences of radial velocities at their opposite edges, but indirect evidence of their rotation is the observed ellipticity. The oblateness $e$ of a rotating body depends on the ratio $\varphi$ of the centrifugal force to the gravity at the star's surface; that is:

$$e = {}_{4}C.\varphi, \text{ where } \varphi = \omega^2 r/g,$$

and as has been proved by Clairaut[1],

$$\tfrac{1}{2}\varphi < e < \tfrac{5}{4}\varphi;$$

$\frac{1}{2}$ and $\frac{5}{4}$ being the limiting cases for the homogeneous and the centrally condensed stars. The constant $C$ as a function of the density distribution, that is, as a function of the polytrope class, was studied by H. N. Russell[2] and recently very exhaustively by S. Chandrasekhar[3].

The general outcome of theoretical investigations is in favour of the conclusion that the globular clusters are built on the model of a polytrope 4 or 5. The constant $C$ changes only slightly within this interval, being 0·501 for $n = 4$ and 0·500 for $n = 5$. In consequence, the value $\frac{1}{2}$ can be accepted for the model of a globular cluster.

In this connexion, the observed ellipticities of the globular clusters are of interest. Generally, the observed value of the ellipticity is not the true one but depends on the orientation of the axis of rotation in space. For the sake of simplicity, we assume that the observed ellipticities are the true ellipticities, and as a mean value was adopted from Shapley's Catalogue of Globular Clusters, the error is insignificant. Ellipticities have been observed in many clusters[4], and in some of them ellipticity shows throughout the cluster from centre to edge. The absolute dimensions of the clusters are approximately known but only scant information on their masses is available. We have adopted for the masses of the clusters $10^5$–$10^7$ ⊙, and the angular velocities were computed for the different values. Referring to our first equations, it may be noted that

$$\omega^2 = 2\gamma \frac{Me}{r^3},$$

where $\gamma$ is the gravitational constant, $M$ the mass and $r$ the radius of the cluster. According to Shapley's determinations, the mean value of the oblateness was assumed to be 0·123, and for the mean diameter of a globular cluster $r = 1{\cdot}078 \times 10^{20}$ cm. was used. The rotational velocity was calculated as a function of the mass, and the results are as follows:

| Mass (⊙ = 1) | Period in years |
|---|---|
| $1 \times 10^5$ ⊙ | $3{\cdot}877 \times 10^8$ |
| $2 \times 10^5$ | $2{\cdot}748 \times 10^8$ |
| $5 \times 10^5$ | $1{\cdot}735 \times 10^8$ |
| $1 \times 10^6$ | $1{\cdot}227 \times 10^8$ |
| $5 \times 10^6$ | $5{\cdot}487 \times 10^7$ |
| $1 \times 10^7$ | $3{\cdot}877 \times 10^7$ |

It follows that the mean period of rotation of a typical globular star cluster is approximately $10^8$ years. This value was deduced on the assumption that the globular clusters are rotating as rigid bodies, which cannot be said to be exactly true, because stars at different distances from the centre of the cluster evidently will have different rotational velocities. The problem is somewhat complicated by the presence of stars in different stages of evolution, but there is a possibility of determining (by star counts) the oblateness and therefore the different rotational velocities for different spectral classes. Such counts have been made by E. Freundlich and V. Heiskanen[5] for $M$ 13. They find that the oblateness increases along the $B - M$ sequence. This interesting result interpreted from the present point of view means that the ratios of angular velocities for cluster stars of different spectral classes are:

$$B : A : F : (G\text{–}K\text{–}M) = 1{\cdot}00 : 1{\cdot}40 : 1{\cdot}48 : 1{\cdot}70;$$

that is, the stars of the $G$–$K$–$M$ types (giants) rotate twice as rapidly as stars of the $B$ type. It would be of great interest to know how far the above results are in agreement with the conditions in our local star cluster.

ZDENĚK KOPAL.
HUBERT SLOUKA.

Štefánikova Hvězdárna,
Praha.
Feb. 10.

[1] Tisserand, "Mécanique céleste", 2, p. 204.
[2] *Mon. Not. Roy. Ast. Soc.*, 88, 641.
[3] *Mon. Not. Roy. Ast. Soc.*, 93, Nos. 5, 6, 7
[4] Shapley, "Star Clusters", chap. vi.
[5] *Z. Phys.*, 14, 226.

## Fire-Walking

MANY of those taking part in the discussion on recent fire-walking performances appear to assume that a normal person would be burnt if his passage over the hot surface were identical with that of the fire-walker, and that a beginner can walk on charcoal or boulders with the same evenness and speed as a trained man. Having thus begged the question, they proceed to offer a variety of explanations, discordant in themselves, and ranging from thickened skin to an extrusion of ectoplasm; thus illustrating once more the futility of propounding theories in the absence of vital experimental data.

As some observers may have a future opportunity of investigating a fire-walk, I would suggest the following tests, based on my experience at the recent performance of Kuda Bux:

(1) Fasten a small thermocouple to any part of the performer's foot which comes into contact with the hot charcoal or stone and connect it to a suitable indicator. The temperature attained by his skin may then be read at the moment he leaves the fire, and if the indicator were watched during the transit it could be noticed whether the same part of the foot was used at each contact. The duration of the contacts and the interval between each should be measured by a stopwatch.

(2) Measure the temperature of the hot surface by pressing on it a thermocouple constructed for this purpose, and connected to a second coil on the indicator which will enable this temperature to be read. Laboratory tests could then be made by raising a surface to this temperature and noting the effect on the skin of a normal subject when applied to the surface for the same periods, and with the same intervals, as those observed in the case of the fire-walker.

(3) Strike the surface of the fire with the palm of the hand, making the same number of contacts as either of the performer's feet and with the same intervals between. If the observer feels that he is

getting burnt he can desist, but I was able to do this immediately after Kuda Bux had left the fire with my hand quite dry without sustaining any injury.

Walking on the fire should be attempted only by those who are certain that they can make the passage with the same speed as a trained fire-walker, as stumbling or hesitation may cause burning. Previous practice on cold charcoal or stone would be necessary, as for half-second contacts the rate of travel is about 3½ miles per hour for a stride of 30 inches.

A small, portable outfit would serve to carry out the foregoing tests, and any good firm of instrument makers would supply the special thermocouples needed, connected to wires insulated with enamel to protect them against the heat of the fire.

If it should prove that the skin of a normal person would be burnt when heated in exactly the same manner as that of the fire-walker, explanations not purely physical will deserve serious attention. Until then they must be regarded as mere speculations.

In conclusion, may I point out to those who still regard the feat of Kuda Bux as supernormal, that my hand had the same experience on the fire as either of his feet, and as I was not under any 'psychic' influence the plain inference is that neither of us attained a temperature high enough to cause burning.

Chas. R. Darling.

## Points from Foregoing Letters

The isotopic weight and 'packing fraction' of several atomic species have been determined by Dr. F. W. Aston with his new mass-spectrograph by comparison of doublets (atoms and groups of atoms having nearly the same mass/charge ratio). Dr. Aston gives revised figures for the relative abundance of various isotopes of cadmium, tin and lead. The existence of Fe 58 and Ni 64 is supported by the experiments of Gier and Zeeman, but evidence as to Ni 61 is still conflicting.

The absorption of slow neutrons by several elements has been measured by C. H. Collie with a more sensitive arrangement. Assuming that the reaction cross-section of boron is inversely proportional to the velocity of the reacting neutrons, the author deduces that the absorption bands of cadmium and indium for neutrons, which partly overlap, occur in the range 0–1·5 electron volts.

If the conservation principles are not obeyed in individual processes between matter and radiation (Shankland) and if there is no coincidence in time between the scattering by an electron and its recoil (Dirac), then, Dr. E. J. Williams concludes, the position and momentum of an electron could be ascertained in certain cases, and Heisenberg's uncertainty principle would be invalid. Dr. Williams has undertaken experiments on the emission of radiation by single atoms to test the conservation principle.

A system of electrical linkage between the tuning systems at the transmitter and the receiver of radio waves used in the investigation of the electrical layers of the upper atmosphere is described by R. Naismith. The new arrangement enables the two stations to maintain synchronism without continuous attention.

By re-plotting previously obtained measurements on the influence of the earth's magnetic field on cosmic radiation, so as to show the effect of latitude (without taking the height into consideration), M. G. Cosyns comes to conclusions which seem to contradict the view that atmospheric absorption alone is responsible for the absence of magnetically soft components in the cosmic radiation at sea-level.

The X-ray diffraction pattern of crystals of protein prepared by the Bence-Jones method is described by A. Magnus-Levy, K. H. Meyer and W. Lotmar. The particle weight of this protein is, according to Svedberg, about 34,000.

The preparation of positive platinum sols by regulated oxidation of negatively charged sols is described by Nathalie Bach and N. Balaschowa. The behaviour of the ultra-microscopic platinum particles is analogous to that of platinum gas electrodes.

The effect of various concentrations of ascorbic acid (vitamin C) and of β-indolyl acetic acid and β-indolyl propionic acid upon the regeneration of willow shoots and the germination of oats, mustard and cress seeds is described by Dr. W. Davies, G. A. Atkins and P. C. B. Hudson. According to concentration, ascorbic acid may either stimulate or retard growth. The indole derivatives seem to inhibit the root growth in germinating oats, mustard and cress at all concentrations, although in dilute solution they stimulate regeneration in the willow.

In the absence of vitamin C, the blood of experimental animals, according to Dr. Frank Marsh, lacks its "complement" (a heat-sensitive substance resembling a ferment, found in the serum, which helps in the destruction of cells in blood). Dr. Marsh considers that this indicates a condition which eventually (four to eight months in man) leads to scurvy, and consequently the test might help in early diagnosis of that disease.

The presence in a few mammary glands of fœtal pigs of additional or aberrant ducts which had proliferated from epithelial ingrowths situated at the base of the nipple are considered by Dr. Alan Deakin as furnishing evidence of the presence of an inducing substance within the nipple, which is responsible for the development of mammary ducts generally.

Prof. G. Herzberg contends that the value derived by Brons from spectrographic data for the heat of dissociation of carbon monoxide (193·3 kcal.) is not necessarily the true one; a value of 209·7 kcal. is also compatible with the available data. This higher value gives a correspondingly higher value to the heat of sublimation of carbon (125·1 kcal.), which is more in keeping with that obtained from thermal data (143 kcal.).

An attempt is made by Z. Kopal and Dr. H. Slouka to determine the axial rotation of globular star clusters using a well-known theorem of Clairaut and the results of theoretical investigations by S. Chandrasekhar. The mean rotational velocity of a typical globular star cluster is found to be approximately $10^8$ years. Using star counts by E. Freundlich and V. Heiskanen in *M* 13, it is concluded that stars of the *G*, *K*, *M* classes rotate twice as rapidly as the *B* stars.

# Research Items

### Stone Age Cultures in Uganda

IN *Man* of March, Mr. T. P. O'Brien, leader of the African Prehistoric Research Expedition, reviews the Stone Age cultures of Uganda on the evidence of the sites throughout the country examined by the expedition. *Kafuan and Oldowan.* The Kafuan pebble culture is the oldest recognisable in Africa, ante-dating Oldowan I. It occurs mostly in gravels deposited by Pluvial I rivers. The implements are mostly small, showing a rough reduction of the edge to produce chopping and cutting tools. The Oldowan type implement is a rough chopper. Oldowan pebble tools are few. *Uganda 'Cromerian'.* A crude large-flake culture found in talus deposits, belonging to a dry period preceding Pluvial II. *Chellean.* A few water-rolled proto- or early Chellean tools are found in the gravels of the top terrace of the Kagera. True Chellean does not occur widely. *Acheulean.* On present evidence appears after a gap. The lowest stratigraphically dated is in Horizon *M*, which marks a climatic break in Pluvial II. The majority of the implements are of large flakes adaptable to the 'wood technique', though only a small proportion actually show real wood technique. It is comparable to Leakey's Stage I–II at Oldoway. Higher up in the same beds and again associated with a climatic break is a later phase of Acheulean, there being no, or little, evidence of intervening stages. In this, the *N* Horizon, there is evidence of deterioration or regression in style. In the *O* Horizon, Upper Acheulean occurs in plenty and well made. The most remarkable feature of this horizon is the appearance of an entirely new culture, previously known from the French and Belgian Congo—the *Tumbian*, of which the characteristic tools are oval or long *bifaces*, which later develop into beautiful *feuilles-de-laurier*. The *tranchet* is common. This culture occurs with the advanced Acheulean, but the relation is not yet clear. *Levalloisian.* First appears between *M* and *N*, and afterwards carries on until it develops finally into Still Bay. *Upper Palæolithic.* The Aurignacian does not occur in Uganda, surprisingly, probably owing to lack of suitable stone.

### Metabolism during Mild Exercise

MUCH attention has been devoted, during recent years, to the effects of hard exercise on metabolism. F. C. Courtice and C. G. Douglas (*Proc. Roy. Soc.*, B, **119**, 382) have studied the effects of the milder exercise of walking ten miles at 4·5 m.p.h. This amount of exercise was insufficient to increase the blood lactic acid, and the conclusion is reached, after discussion, that the respiratory quotient gives a trustworthy indication, under these conditions, of the nature of the foods metabolised. During the exercise the respiratory quotient (*R.Q.*) rose owing to increased carbohydrate metabolism. After the exercise the *R.Q.* fell, and acidosis and ketosis developed, owing to increased metabolism of fat. If the subject had consumed much carbohydrate on the day before the exercise, there was no evidence of increased fat metabolism after the exercise. The consumption of carbohydrate just before the exercise did not have this effect (see also NATURE, **136**, 1001; 1935).

### Fertilisation in *Acacia Baileyana*

DR. I. V. NEWMAN has published two further papers which complete his investigations on the life-history of *Acacia Baileyana* (*Proc. Linn. Soc. N.S.W.*, **59**, parts 3–6). The carpel is found to arise as a single folded foliar structure with ovules inserted along the margins. The integuments are only formed after fertilisation, and the megaspore is possibly smaller than the microspore. The anther is regarded as containing eight sporangia, each with a one-celled archesporium which develops into a 16-celled pollinium. This condition should make it possible to determine definitely whether the split in the chromosomes is suppressed in the last promeiotic telophase. The pollen grains germinate in the anther, cutting off a generative cell which becomes spindle-shaped, has a definite membrane, and cytoplasm less dense than that of the grain. The pollen was grown successfully on 1 per cent agar with 20 per cent sugar solution. As the legume contains only 12 ovules, a pollinium on the stigma furnishes an excess of pollen tubes and two frequently enter the same embryo sac. Evidence was obtained that the extra male nuclei fuse with the polar nuclei, producing endosperm with occasionally as many as $7n$ or $8n$ chromosomes. The mature sac becomes filled with starch grains, and after fertilisation the endosperm nucleus divides to form about 64 free nuclei before wall-formation begins around the embryo.

### *Hemimerus*, a Parasite of the Giant Rat

MESSRS. JAMES A. G. and John W. H. Rehn have recently published an article revising the species of *Hemimerus* (*Proc. Acad. Nat. Sci. Philadelphia*, **87**, 457–508; 1935). This genus is allied to the earwigs, but is wingless and eyeless, with the hind body terminating in thread-like cerci, instead of forceps. So far as is known, the species of *Hemimerus* only occur as ectoparasites on terrestrial giant rats of the genus *Cricetomys*. The hosts, as well as the parasites, are limited in distribution to tropical Africa. The most important fundamental studies of these curious insects have been made by Dr. Heymons who, in 1905, showed that the offspring are produced viviparously, a peculiar kind of placenta enabling them to undergo their development on nutriment provided by their female parent. The adaptations of *Hemimerus* are those of a true parasite which lives externally on its host. The food appears to consist of epidermal products and of a fungus which possibly grows on the skin of the host. Messrs. Rehn have examined 343 specimens of the insect from various parts of Africa, and find that their distribution ranges from Portuguese Guinea, across the continent to Mozambique and the north-eastern Transvaal. The northern and southern range cannot be accurately defined at present, owing to paucity of material or records, from areas where it and its host undoubtedly occur. The authors redescribe the three species already known, and recognise five other species previously unrecorded. The paper is accompanied by a full bibliography of the genus and forty-seven figures illustrating diagnostic characters.

### Control of Antirrhinum Rust

THE fungus *Puccinia antirrhini*, causing a rust disease of snapdragon plants, has established itself firmly in England during the last two years. This fact renders any experiments upon its control of more than passing interest. Mr. D. E. Green has conducted an extensive series of such experiments, using nine types of spray fluid, and three fungicidal dusts (*J. Roy. Hort. Soc.*, 61, Pt. 2, 64–76, February 1936). Copper-containing sprays were found to be effective, and of these, Burgundy mixture was the most suitable. Control was not absolute, however, and as it was considered that at least six sprayings were necessary, this method is likely to daunt even the *Antirrhinum* enthusiast. Mr. Green is, however, trying another method, namely, the raising of rust-resistant snapdragons, and the results of these trials will be awaited with great interest. They give high promise already.

### Tulip Fire Disease

TULIP fire caused by *Botrytis tulipæ* is the most serious disease that attacks the tulip crop, and a descriptive account of it, with control measures, is given by A. Beaumont and others (*Ann. App. Biol.*, 23, p. 57). The blooms on attacked plants are rendered quite unmarketable, but though the direct loss on account of diseased bulbs is small, the indirect loss is by no means negligible where the flowers are 'topped', as a substantial increase in size is made during the period subsequent to 'topping'. No varieties are known which are completely resistant; but the degree of susceptibility varies; Baronne de la Tochnaye, for example, seems to be the most resistant tulip in the Devon–Cornwall district. A close correlation exists between meteorological conditions and the incidence of tulip fire, rainfall and humidity being the most important factors as they are the conditions necessary for germination and infection. Three types of symptom occur, fire, spot and rot. Fire is a primary infection and appears as grey lesions on leaves, flowers and capsules, whereas spot arises secondarily from spores derived from fire lesions. Rot is less common, and attacks the bulb only, although the resulting plant is sickly and generally fails to flower. Control measures are bound up with proper cultivation. Bulbs should be lifted every year and planted, preferably deeply, in fresh soil. Late planting and wide spacing are advocated, while careful roguing and destruction of diseased plants with avoidance of mechanical injury are also of the first importance. Various methods of chemical control have been tried, but the results have not yet met with much success. Further experiments in this direction are in progress.

### Timber Seasoning

THE fourth number of the *Forest Products Research Records*, published under the auspices of the Department of Scientific and Industrial Research, deals with "Timber Seasoning", by R. G. Bateson. The importance of this investigation is that it deals with both air seasoning, the old common method, and kiln seasoning. Of particular interest from the practical householder's point of view is the statement that it is not possible to dry timber out of doors in Great Britain sufficiently for use in artificially heated buildings. "Under the most favourable circumstances," says the author, "the moisture control might conceivably be reduced to about 12 per cent in the height of summer but 18 per cent represents a far more usual figure; whereas a moisture control of 9–12 per cent is required for interior wood work in centrally heated buildings". In the experience of the present writer, old air-seasoned Scots pine panelling dating from about the middle of the eighteenth century cracked badly when central heating was introduced into the house, whilst oak panelling stood up much better—but both examples prove the contention of the author. In this connexion, the author points out that certain 'refractory' hardwoods which take months to season in the kiln, can be kiln seasoned in a week or two if air seasoned for a year or two previously. This would appear to show that there is yet something to learn about air seasoning in the case of some species of, and probably the finer, timbers.

### Magnesium Metasomatism

AN important paper by N. Sundius on "The Origin of Late Magmatic Solutions containing Magnesia, Iron and Silica" appears in *Årsbok*, 29, No. 7, of the Sveriges Geologiska Undersökning. The sulphide ores of Fennoscandia are often associated with quartz-rich rocks containing magnesium-, iron- and aluminium-bearing minerals such as micas, cordierite, amphiboles and garnet. Almost invariably the presence of these minerals has been ascribed to metasomatic changes due to the introduction, often through great distances, of oxides from some external source of supply. Locally, the metasomatic rocks have been sufficiently mobilised to act as intrusions towards their own country rocks. A peculiar feature of the scarn and ore occurrences in which magnesium metasomatism is manifested is the scarcity of evidences of volatile substances of the kinds usually regarded as pneumatolytic carriers. Sundius discusses a number of examples and concludes that a supply of outside agents is not always necessary, but that magmatic differentiation products corresponding to the minerals in question may be concentrated from a magma as residual solutions and may crystallise *in situ* or be squeezed out into the adjoining country rocks. Water at high temperature is regarded as the chief cause for the production of such late-magmatic solutions. The latter are supposed to contain hydroxyl-bearing compounds, probably silicates, and possibly aluminates and ferrites. Metasomatic activity on the part of the water-rich magma solutions is favoured by the diminished stability of earlier-formed felspars in their presence. The author admits that vaporisation of metallic compounds from the magma may have played a prominent part in some cases, though, he adds, no examples have as yet been clearly revealed. The problem is far from being solved and Sundius himself warns petrologists that "a rigorous application of the theory here developed is not advisable".

### The Southern Alaska Range

S. R. CAPPS has recently described an area of some 23,000 square miles which was still largely unexplored when the surveys reported were begun in 1926. (U.S. Geol. Surv., Bull. 862). The parts of the Range now described reach heights up to 12,000 feet and include a labyrinth of rugged mountain crests and valley glaciers. One of the highest mountains of the region is Mount Spurr, a volcano which still shows signs of mild activity. Other volcanoes lie to the east, forming part of the great line of vents that stretches along the Alaska Peninsula and the Aleutian

Islands. The oldest rocks of the region are gneisses, mica-schists, crystalline limestones and quartzites, known to be pre-Triassic and thought to be Palæozoic in age; they may, however, be Pre-Cambrian. Less highly metamorphosed Mesozoic sediments follow, cut by gigantic intrusions of a general granitic character. The age of the Mesozoic sediments in the Alaska Range has proved difficult to determine, as the rocks consist of a monotonous alternation of argillaceous rocks and graywackes which are almost devoid of fossils. Just why those particular Jurassic and Cretaceous seas should have been so inhospitable to life is a baffling problem, for near by, in the Pacific littoral belt of the Alaska Peninsula, a prolific fauna flourished during those periods. Near the shores of Cook Inlet there are extensive deposits of Tertiary lignitic coal, but at present more accessible supplies are available for the local market. Lodes carrying promising amounts of gold and silver have been discovered near the borders of granitic intrusions, but lack of transport facilities has so far retarded development.

### Organic Liquids in Diffusion Pumps

K. C. D. HICKMAN (*J. Franklin Inst.*, February) has studied the behaviour of organic liquids used to provide the vapour stream in diffusion pumps, and he has been able to clear up some of the inconsistencies in reports of their behaviour. The liquids—the Burch vacuum oils and such esters as dibutyl phthalate—always contain traces of relatively volatile substances, and in the operation of the pump these substances collect in the high vacuum region, spoiling the vacuum there. They then redissolve in the condensate and are not eliminated by the backing pump. The author constructed a two-stage pump in which interconnexions ensured that the more volatile constituents were transferred to the rough pump, while the high-vacuum pump operated with the best fraction of the vapour. The pump gave a much better vacuum under these conditions than in the case where the interconnexions were changed to reverse the direction of fractionation. A further development was the construction of a fractionation pump in which successive fractions of the pumping liquid were used in successive vacuum stages. A practical form of this pump is to be described in a future paper.

### Potassium Isotopes in Minerals and Plants

THE question of the variation in the isotope ratio of potassium in plants has received conflicting answers, the balance of evidence being that there is no isotope effect. The element has three isotopes, 39, 40 and 41. The abundance ratio $K^{39}/K^{41}$ has been determined, with somewhat varying results. A. K. Brewer (*J. Amer. Chem. Soc.*, 58, 365; 1936), using the mass-spectrograph, with a constant velocity source permitting the entire primary ion beam to be focused on the entrance slit, and a Dempster type analysing chamber, finds the ratio $K^{39}/K^{41} = 14 \cdot 27 \pm 0 \cdot 04$ for Vesuvius lava. Most other minerals examined show only small differences, the abundance ratio being in general near 14·25. A low value ($14 \cdot 11 \pm 0 \cdot 03$) was obtained for Hawaiian basalt and a high value ($14 \cdot 6 \pm 0 \cdot 05$) for wyomingite (a lava). The results obtained with 32 plant ashes show distinct variations in the isotope ratio, the $K^{41}$ content differing between plants by as much as 15 per cent. Kelp shows the most pronounced deviation ($12 \cdot 63 \pm 0 \cdot 20$) from the general average. It is interesting to note that plants have likewise been shown to exhibit a selectivity in the case of heavy hydrogen. The factors contributing to the abundance ratio variations appear to be the variety of plant age, soil and section of plant. In a second paper (ibid., p. 370) the same author reports that the abundance ratio for Pacific water is 14·20, no appreciable variations being observed between samples from different localities or at points down to 2,500 m. in depth. The value for the atomic weight is calculated as 39·094, in close agreement with the value accepted by the Committee on Atomic Weights.

### Effect of Weather on 132-kilovolt Line Insulators

THE experience gained during the last few years in the running of the Grid in Great Britain under all kinds of weather conditions has shown that the behaviour of the 'chains of insulators' needs close study. In industrial areas, or where the atmosphere is polluted, flashovers occur, although the lines are adequately insulated according to the usual standards and the insulators are regularly cleaned. In a paper read to the Institution of Electrical Engineers on February 19 by J. S. Forrest, an investigation with the object of finding out which kind of insulator is most suitable for use under foggy conditions is described. The investigation was carried out at the Croydon transforming station of the Central Electricity Board. It was found that in fog or with dirty insulators under humid conditions, the leakage current is very unsteady, and continuous 'surging' often takes place. These current surges are due to surface discharges on the insulators and are usually self-extinguishing, but a severe surge may develop into a complete flashover. The experiments have led to a testing technique to determine which of the available types of insulators is most suitable in neighbourhoods subject to fogs. It is found that the frequency and magnitude of the current surges give a criterion by which the performance of insulators can be judged. It is unnecessary and therefore uneconomical to clean tension insulators as often as suspension insulators. It is probable that the better performance of the tension chains is due to the more efficient cleaning by rain and to the less tendency for leakage-current surges to develop into complete flashovers.

### Radial Velocities of 100 Extra-Galactic Nebulæ

THE discovery of the enormous velocities of recession of some of the spiral nebulæ, together with the distance-velocity relation and its resulting hypothesis of an expanding universe, has led to a more intensive study of the radial velocities of these objects. The 100-in. reflector at Mount Wilson has already been used for determining the radial velocities of many nebulæ, and now a further list of 100 velocities has been published by Humason (*Astrophys. J.*, 83, 10) in which the range in distance of the observed objects has been greatly increased. This list includes values for nebulæ in clusters or groups as well as for 56 isolated nebulæ; and the velocities found, with six exceptions, are all of recession, ranging from 50 km./sec. to 42,000 km./sec. When correlated with distance, these results indicate that the velocity-distance law is still sensibly linear up to the distance of 70 million parsecs (the estimated distance of the clusters in Boötes and Ursa Major).

# Conference on the Teaching of General Science

A SUB-COMMITTEE of the Science Masters' Association, acting in collaboration with the University of London Institute of Education, recently organised a one-day conference on the teaching of 'general science'. The problems discussed have caused much controversy during the past few years. The panel of investigators on the School Certificate examinations recommended the adoption in schools of courses covering the main principles of elementary physics, chemistry and biology instead of more specialised courses covering only one, or part of one, of these subjects. At the annual meeting of the Science Masters' Association in 1934 this recommendation was endorsed. The movement is supported by those who consider that some study of biology should be part of the education of every child, as well as by those who wish school science to be less formal and less academic than it often is. It is opposed by those who fear superficiality of treatment and who feel that they can train children's minds more satisfactorily by using a more restricted medium. The large attendance at the conference, and the keen discussions which ensued, illustrated the general desire to thrash out the issues involved and to pool experience and knowledge.

Sir William Bragg took the chair at the first of the five meetings and initiated a discussion on "The Aims of General Science". The educated man, he said, should be aware of the main lines of development of human thought and, to-day, this involves an appreciation of the scientific attitude. It is important, too, that an intellectual atmosphere be fostered which is unfavourable to a misapplication of the fruits of research, due to lack of knowledge. Dr. Titley (King's College) amplified these remarks, and considered in detail aims which have been widely accepted. In particular, he gave a careful résumé of present views regarding the mind-sharpening value of scientific studies. He pointed out that exercising the mind within a narrow and specialised range might give it great power, but only in a very restricted field. The keen discussion which followed these stimulating addresses revealed fair unanimity of views. Clearly, it was found difficult to distinguish between the general aims of science teaching and the aims of general science, but this is an argument in favour of the latter. The teaching of 'Heat, Light and Sound', for example, would certainly not allow the attainment of the aims admitted.

Prof. E. N. da C. Andrade took the chair at the second meeting, the subject being "The Content of the Course". He admitted that wider syllabuses might lead to some superficiality of treatment, but could see no particular harm in this. Even the building up of 'balanced' courses, he thought, was really unessential. A scientific attitude and a love of science could best be fostered by a teacher who cast his net wide, but was not afraid to follow up his own pet hobbies. Prof. H. E. Armstrong should have followed Prof. Andrade but was unfortunately compelled to be absent for health reasons. He sent, however, a stimulating and provocative message. Mr. C. L. Bryant (Harrow) then gave details of the minimum syllabus in general science which has been drawn up by the special sub-committee of the Science Masters' Association. The proposals were well received, though it was felt that a more optimistic attitude regarding time-table allowance would have been desirable. Many of the best schools give twice as much time to science as is contemplated by the sub-committee.

At the first afternoon meeting, held under the chairmanship of Mr. H. T. Tizard, problems of unification and correlation were considered. Mr. W. G. Greaves (Ledbury Grammar School) criticised the use of the topic method of teaching, in which topics such as air, water, measuring instruments, etc., are studied and no attempt is made to keep the subjects separated. He considered this to be useless as a method of unification, admirable though it might be as a teaching device.

Mr. J. A. Lauwerys (Institute of Education) discussed the point as to whether there was sufficient unity in the various branches of school science to make it a single subject. He put more faith in the integrating powers of the intellectual digestion of the adolescent mind than in those of various syllabuses or methods. Topics would certainly be useful in the first two years of study, but there was no reason to avoid 'subjects' at a later stage when logical interconnexions could be demonstrated and understood. The hints and comments made by speakers who took part in the subsequent discussion will probably be useful to those who are attempting to make their subject more interesting and valuable to the average pupil.

Sir Philip Hartog then took the chair for a discussion on examinations. He had been struck during the discussions, he said, by the importance attached to examination requirements. It appeared that examinations held the educational system in a stranglehold. He suggested that teachers should be clear as to the aims of their tests: they should know, for example, whether they were testing progress or utilisable skills. He recommended them to study the new-type questions, which the Americans have done much to develop.

The subsequent discussion, initiated by Mr. S. V. Brown (hon. secretary of the S.M.A.) and Mr. F. W. Turner (Morley Grammar School), showed that most teachers deplore the restrictive influence of examinations on their work. Though ready to admit that external examinations are not valueless, they would like to see fundamental alterations and improvements.

The three addresses to the last meeting—on "The Teacher of General Science"—admirably summarised the previous arguments. The chairman, Prof. H. R. Hamley (Institute of Education), Mr. W. H. Jenkinson (Sheffield) and Mr. L. G. Smith (Marylebone Grammar School) developed various aspects of this topic. The discussion which followed revealed unanimous agreement with their views. To make school science a valuable and useful part of a liberal education the right teachers must be provided by the universities. They must be enthusiasts who should know not only their own subject but also the role which it plays in the greater whole of which it is a part. Clearly

a wide and generous training in science would do more to provide such people than the narrow and intensively specialised courses favoured by some universities.

It is possible that the conference did not reach conclusions as explicit and as concrete as some might have wished. Nevertheless, the addresses and discussions were highly appreciated and were found stimulating and helpful. Wide agreement with the ideals of more generalised science teaching was shown, though it was evident that quite a number of teachers are not yet convinced of its benefits.

# Food and the Family Budget

THAT the social and economic aspects of national nutrition are evoking great public interest was shown by the crowded audience at the joint meeting of the Engineers' Study Group on Economics (E.S.G.) and the Association of Scientific Workers, held on March 31 at the house of the Royal Society of Arts, London. In a short introductory speech, Sir Richard Gregory urged the importance of investigating the causes why commodities that can now be produced in abundance, thanks to science, are not available in sufficient quantities to raise the standard of living of the people. He then called upon Dr. E. H. Tripp to present and explain the Group's report on "The Design of a Family Budget, with special reference to Food".*

The main finding of the report is that the statistical average family of 3·72 persons requires annually, for adequate living, goods and services now costing about £317, a sum equivalent to a weekly expenditure of about 63*s*. per wage-earner. About 82 per cent of 'families' are now earning less than this amount.

The chief items in the prescribed 'family' budget are (per annum): food, £99; rent and rates, £55, the type of house envisaged being one containing a living-room, three bedrooms, kitchen and bathroom, costing £600–£800 inclusive of land; clothing, £28; fuel and light, divided between gas, electricity and but little raw coal, £21; smoking, liquor, and sweetmeats, £28 (present national average £35). Provision is made for an annual holiday, £10, and for travelling, £20 (present national average £22).

Of especial importance in the prescribed dietary are the health foods, fresh dairy produce, eggs, meat, vegetables and fruit. The cost works out to 10*s*. a head per week, as compared with 9*s*., the current national average; and the conclusion is that a large section of the population has not the purchasing power needed to obtain the foods required for full health and working capacity.

In opening the discussion, Sir John Orr welcomed the fact that scientific workers have now begun to apply their knowledge and methods to social and economic problems, which cannot well be studied in water-tight compartments. The report of the E.S.G., he said, embodies an excellent study, and it is very remarkable that by approaching the subject from a totally different point of view and by different methods, the Group has reached a conclusion very close to that at which he and his colleagues arrived. Food requires a special place for itself. Whereas expenditure on items like entertainment, sport, and reading may vary from nothing to £1,000 a year, that on food varies much less from class to class—not more than from 4*s*. to 14*s*. a head per week between the poorest and the wealthiest. Appetite is limited, and although one might pay £1 for a dinner in London, one could not eat more than 10*s*. worth of food, at retail prices. Also, the State has assumed a special liability for food by undertaking to treat and cure diseases due to an inadequate diet. Very few people starve nowadays, but many lack a diet sufficient to maintain good health. To provide an adequate diet for all people below the income-level of £317 per annum would involve, at retail prices, an increase in the national expenditure of about 5–6 per cent; but a cheaper method, and one more likely to be adopted, would be to cheapen the protective foodstuffs so that all could buy them; and that would reduce the increased expenditure to 1–2 per cent. More study and more criticism are needed to evoke concrete propositions; and once the bulk of the people is convinced, great improvement would follow.

Sir Daniel Hall said that if we increased the amount of home-grown food from the present figure of less than 40 per cent to more than 50 per cent of our total supplies, agricultural conditions would have to be revolutionised. We should certainly grow all the protective foodstuffs we can, and our land is specially suited to grow them. He disapproved the policy of subsidising wheat and sugar because they are needed in war-time; they are concentrated foods that are obtainable from our colonies, and occupy relatively little space in a ship's hold. As our farmers are now being assisted to the extent of more than £40,000,000 per annum, they could reasonably be expected to grow what is best for the country.

Mr. G. D. H. Cole agreed with the main points of the report, but regretted that the cost of education was not discussed. The food budget was certainly no more than is desirable, and it would probably be necessary to provide a larger total income. Urgently needed now are more data on expenditure at the £6–£10 a week income-level, and a new complete inquiry into working-class budgets.

Mr. A. E. Feavearyear commented on the cost of the improved housing prescribed in the E.S.G. budget. There are now some 10½ million houses in the United Kingdom, worth £4,000–£5,000 million at present prices. Assuming a house to last a hundred years, the annual cost of replacement would not amount to £50,000,000. He advocated a fairly rapid replacement of all houses below the E.S.G. standard —not less than 3 millions—but that would cost at least £1,500,000,000, or more than the entire net annual savings of the nation for five years.

Lady (Rhys) Williams described a study of infant and maternal mortality as affected by nutrition, carried out in the Rhondda Valley under the National Birthday Trust Fund. Necessitous mothers were given vitamin-bearing foods and 1 pint of milk a day for at least three months, with the result that the maternal death-rate fell from 11·29 in 1934 to 3·9 in 1935.

* Obtainable from A. H. Hayes, Hazlitt House, Southampton Buildings, Chancery Lane, W.C.2. Price 6*d*. (by post 7*d*.).

Mr. G. P. Crowden referred to the work of the British Medical Association and said that further efforts are needed to strengthen the link between laboratory and kitchen. He suggested the establishment of a central bureau to give information on matters relating to family nutrition, and that purveyors of foodstuffs might assist purchasing and distribution by offering attractive terms to housewives for weekly supplies of items in the dietary scales recommended.

Dr. G. C. M'Gonigle thought the E.S.G. report a notable contribution to family economics. He has analysed many budgets of the lowly paid and unemployed, and has found that the relatively low standard of the B.M.A. minimum dietary cannot be achieved under a family income of 55–65s. a week. High rent is a great obstacle. Contrary to popular belief, he found that the average working-class woman has a sound empirical knowledge of practical dietetics, and to the limit of her purse buys wisely and well.

# Micro-Ray Communication

IN engineering, the progress of the evolution of inventions seldom proceeds along a straight line, each step leading directly and logically to its successor. The evolution often proceeds in a looped path, new inventions apparently returning to an earlier stage of development before making a new start in another direction. This is illustrated in a paper read by W. L. McPherson and E. H. Ullrich to the Institution of Electrical Engineers on January 30.

In describing the recent commercialisation of micro-ray transmissions for radio communication, the authors point out that it was with micro-rays that Hertz in 1887 performed the classic experiments which are generally admitted to have led to the wireless communication of to-day. Hertz succeeded in generating by means of a spark transmitter wavelengths of 30 cm., and in proving conclusively that the radiation due to such circuits followed the optical laws of reflection, refraction and propagation. He thus verified Clerk Maxwell's work done twenty-two years previously. Hertz's investigations read almost like an experimental and theoretical study of light. They include the measurements of the angles of incidence and reflection from plane sheets of metal, reflection from curved metallic mirrors of definite focal length, refraction through prisms of pitch and studies in transparency and opacity. Owing to lack of sensitivity on the receiving side, Hertz's experiments bore no immediate fruit although scientific workers were greatly interested in them.

The invention of the large aerial and of tuning, and the success of medium and long wave operation, led to practically total neglect of micro-ray technique until 1919, when Barkhausen and Kurz discovered a new type of oscillatory circuit which generated wavelengths down to about 43 cm. The first large-scale demonstration of modern micro-ray working was made between St. Margaret's Bay, near Dover, and Escalles, near Calais, a distance of 22·1 miles. The wave-length used was only 18 cm. and so the waves radiated like light waves, permitting the use of reflecting mirrors. In January 1934 a micro-ray link for commercial service was opened between the aerodromes of Lympne in England and St. Inglevert in France, covering a distance of thirty-five miles. It provides a duplex service on radio-telephony, teleprinter or Morse telegraphy as required. The wavelength is 17·4 cm., which is the shortest of any station in the world.

Experiments have shown that atmospherics of the ordinary type are never heard on the St. Margaret's circuit, although a few sharp clicks are sometimes noticed the origin of which has not yet been traced. Thunderstorms occurring even in sight of the receiving station cause no interference. The ignition systems of aircraft or motor-boats also have no effect. It was found that the strength of the received signals did not remain constant. On three occasions the signal was uncommercial in telegraphy for periods of about two minutes. When a 600 cm. wave-length was used, no variation of the received signal was ever detected.

Diagrams are given of the working signal current operating the teleprinter at Lympne and of the state of the tides at the same times. Although the effect of the tides may be masked in many instances by other fading causes, the records suggest that they are a factor in causing fading. In nine cases out of ten, the turn of the tide, during a week's record, was accompanied by a marked change in the slope of the signal current curve. This supports the hypothesis that there exists interference due to the indirect ray reflected at the sea surface.

The authors conclude that the primary condition for good micro-ray working is a thoroughly well-mixed and homogeneous atmosphere. In the summer, currents of hot air probably create 'pockets' of very different refractive power from the rest of the atmosphere, so that the direction of transmission may be violently changed and unusual attenuation introduced. In summer, the passage of a cloud across the sun's rays gives a temperature 'kick' the magnitude of which is different when above land than when above the sea, owing to the difference in reradiation in the two cases. The path of the St. Margaret's–Escalles link is at first sight simpler, as it is nearly all above the sea; but at the faces of the cliffs near the stations strong currents of hot air often arise, and this would introduce a compound lens effect in the path of the transmission rays.

The results obtained by the practical working of the two 'links' described in the paper may be summarised as follows. The most stable micro-ray conditions coincide with very stable atmospheric conditions, as judged by thermometer and barometer. A high wind is almost invariably accompanied with good micro-ray transmission. The settling of a heavy bank of fog has been accompanied by very severe and rapid changes in the reception, followed by stability when the fog bank has ceased to move. Radio waves, six metres in length, are much more stable than micro-waves over optical paths across the Straits of Dover. It is much more difficult to tap micro-wave communications than those which use longer wave-lengths. Hence when secrecy is necessary, as in military operations, they are more desirable.

# Molasses, Nitrogen Fixation and Land Reclamation

IN his presidential address to the United Provinces Academy of Sciences, India, on December 19, 1935, Prof. N. R. Dhar gave a general account of the work carried out by himself and his collaborators on nitrogen transformations in soil. Prof. Dhar leads the school of thought which believes that nitrification in soils and nitrogen fixation from the atmosphere are, especially in the tropics, photochemical at least as much as bacterial actions. Prof. Dhar has produced strong evidence in support of his theories, and the question appears now to have reached the stage at which the protagonists of bacterial and photochemical nitrification respectively are unwilling to admit any evidence which might shatter their beliefs.

Meanwhile, other soil workers will be wise to keep an open mind on the matter, for the philosophical implications of recognising that light plays a part in soils analogous to photosynthesis in the vegetable kingdom are at least as important as the practical possibilities of utilising that knowledge for the enrichment of the soil. Given sufficient facts, their practical application does not necessarily depend on their correct interpretation. The practical facts of Prof. Dhar's researches are that Indian soils are generally deficient in nitrogen, that more than half a million tons of molasses from the sugar industry are annually wasted in India, and that the application of molasses to the soil can double and may treble the soil nitrogen content, with a consequent large increase in crop yield.

Molasses contains about 70 per cent of carbohydrates and small quantities of nitrogen, phosphorus, potash, etc., these quantities, however, being much too small to account for the observed manurial effect. According to Prof. Dhar, the energy set free in the oxidation of the sugars in molasses is utilised, either bacterially or photochemically, in promoting nitrogen fixation and nitrification. Whatever the nature of the process, Dhar has produced indisputable evidence of increases in available soil nitrogen and crop yields following the application of molasses. Under temperate conditions, the converse result would be expected, as it is well known that the addition of carbohydrate-rich material to soil tends to reduce the amount of nitrogen available to plants, the nitrogen becoming fixed as microbial protoplasm or as humus. An essential difference, however, between temperate and tropical soil requirements is that, whereas in temperate regions the limiting factor to crop growth is often the slowness, in the tropics it is the rapidity with which soil nitrogen is made available to plants, soluble nitrates being formed and leached from the soil before they can be absorbed by the crop. The general effect of molasses on the soil should be the same everywhere, but only in the tropics will its 'braking' effect on the mobilisation of soil nitrogen be a positive advantage to the cultivator, and only in the tropics will its stimulation of atmospheric nitrogen fixation, whether bacterial or photochemical, be appreciable, since temperate regions lack the heat necessary for bacterial and the light for photochemical stimulation.

For these reasons, the potentialities of carbohydrate manuring—of which molasses manuring is an example—have perhaps been overlooked by agriculturists. If Prof. Dhar can substantiate his claims, he may effect a revolution in agriculture in India, where the supply of the ordinary organic manures is far below the demand. Prof. Dhar suggests that a most valuable use can be made of molasses in reclaiming alkaline land. The acids produced in the decomposition of molasses neutralise the alkalis, and at the same time and contrary to experience when land is reclaimed with gypsum or sulphur, soil nitrogen is increased. A period of about four years is usually necessary to reclaim alkali land with gypsum, whereas with molasses applied at a rate of 30–40 tons per acre, good crops can be grown within six months. It is not stated whether such reclamations have been found permanent—in view of the oxidisability of the neutralising acids, this is open to doubt—but the method obviously merits further study. There are four million acres of infertile alkali land in India, and irrigation practices are increasing the area. The economic reclamation of these lands is one of the country's greatest agricultural problems, to the solution of which Prof. Dhar's work is pointing the way.

# The Prehistoric Society

WITH the publication of its *Proceedings** for 1935, the Prehistoric Society, formerly known as the Prehistoric Society of East Anglia, completes the first year of its existence under the new style and organisation. The change will necessarily bring some broadening of outlook; but those who have followed with close attention the work of the Society under its old style, especially in recent years, are well aware that the change is one in form rather than substance. From the time of its first formation in 1908 the Prehistoric Society of East Anglia, though strong in its local membership, reaped the advantage of its geographical position. It had the strategic advantage that many of its local discoveries and local problems were of more than local interest; they were also of the first importance in the discussion of some of the most significant of the questions relating to the antiquity of man and prehistoric archæology at large. A glance through the later volumes of the *Proceedings* will show that the proportion of attention given to these larger questions and the tendency to view local evidence in the light of its bearing on the broader issues had steadily increased, until the Society, so

* Proceedings of the Prehistoric Society for 1935 (Proceedings of the Prehistoric Society of East Anglia, 1908–1935). Edited by Dr. Grahame Clark. Pp. 164+15 plates. (Cambridge: University Museum of Archæology and Ethnology.) £1.

far as its proceedings were concerned, had earned the right to be regarded as a national rather than a local body. That fact is recognised in the change of title. On the other hand, the strength gained from local interest will be preserved by an organisation of local groups under honorary secretaries, which will focus interest in specific local areas.

Thanks very largely to the activities of Mr. J. Reid Moir, the Prehistoric Society has never feared the difficulties which beset the pioneer in archæological investigation; and if we may judge by the contents of the first volume of its *Proceedings*, the same policy will commend itself to the Society in its revised form. It will offer a free field for open discussion. This at least is the inference to be drawn from the tone of the first presidential address by Prof. V. Gordon Childe on "Changing Methods and Aims in Archaeology". Pointing out that the remarkable strides in discovery of prehistoric archæology during the last ten years call for a complete reconsideration of the position in prehistoric studies, he focuses a variety of 'discontents' expressed in various quarters, and boldly accepts their implication of the necessity for certain fundamental changes of nomenclature, point of view and method. For example, while he holds that chronology is the essential of prehistory, as it is of history, the old chronological classification of 'ages'—stone, bronze, iron—can no longer be regarded as bearing any precise significance, owing to the wide distribution in time as well as in space to which it is now recognised these terms are applicable as cultural designations. On the other hand, as he himself has already suggested, the various 'ages' do express phases in economic development, which have their place in a temporal relation, thus becoming even more significant when viewed in the light of Prof. Childe's reference to the present aim of archæology, which centres not so much on the intrinsic interest of the objects recovered as in the reconstruction of the culture of which they are an indication.

Prof. Childe dismisses in like vein the familiar chronological classification in a sequence of cultures based on the archæological finds of France, which no longer applies in the world-wide view of prehistoric problems which must now be taken. But in dealing with this and other concepts hitherto generally accepted, his criticism—a constructive criticism be it said—is that the implication of the emphasis now laid on culture must be accepted to the full. It is no longer the period, but the culture which is the object of investigation. The chronological problem is to be solved through the relation in space and time of the various distinguishable cultures *inter se*.

Of the varied communications which follow the presidential address a bare mention of a few must suffice. Mr. G. A. Holleyman and Dr. E. Cecil Curwen describe their investigation of bronze age lynchet settlements on Plumpton Plain, Sussex. This produced some interesting pottery which is described by Mr. C. F. C. Hawkes. The pottery confirms and emphasises the distinction in date between site *A*, which belongs to the earlier Late Bronze Age from about 1000 B.C., and site *B*, which cannot be dated before 750 B.C. and covers the transition to the Early Iron Age centring approximately on 500 B.C. Mr. Henry Bury provides a welcome discussion of the Farnham terraces and their sequence and Dr. Grahame Clark furnishes an equally opportune survey of the prehistory of the Isle of Man.

The recent discussion, at the Norwich meeting of the British Association, of the antiquity of man in East Anglia, gives a special interest to papers by Mr. Reid Moir on the Darmsden flint implements and a description of three Combe Capelle hand-axes from Norfolk; and a similar interest in a different context is attached, in view of recent discoveries in the county of Lincoln, to three papers dealing with long barrows—a description of the Therfield Heath Long Barrow, Royston, by Mr. C. W. Phillips, a discussion of a possible pedigree of long barrows and chambered cairns by Mr. W. J. Hemp, which is both suggestive and to some degree provocative, and a note on the relative chronology of English long barrows by Mr. Stuart Piggott. Mrs. Jacquetta Hawkes adds to her previous contributions to consideration of the place of origin of the Windmill Hill culture and advances her views a stage further.

A valuable feature of the miscellaneous items which complete the volume is a survey of results in the field in Great Britain and Ireland during 1935. Mention must also be made of a valuable résumé of recent work in Russia by Prof. Gordon Childe.

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## Educational Topics and Events

CAMBRIDGE.—The following have been approved for the degree of Sc.D.: W. N. Bailey, of Trinity College, C. G. Darwin, Master of Christ's College, J. O. Irwin, of Christ's College.

At King's College, Dr. D. Purdie has been elected into a fellowship. Dr. Purdie was placed in the first class of the Natural Sciences Tripos, Part II, in 1932, and was elected to a Charles Kingsley Bye-Fellowship at Magdalene College in 1934.

EDINBURGH.—Prof. W. H. McMillan, professor of mining in University College, Nottingham, has been appointed to the James A. Hood chair of mining in the Heriot-Watt College.

LONDON.—Prof. A. K. Henry has been appointed as from March 1 to the University readership in surgery tenable at the British Postgraduate Medical School. Since 1925 he has been professor of clinical surgery in the Medical School, Cairo, and director of the Surgical Unit, Kasr el Aini Hospital, Cairo.

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LOUGHBOROUGH COLLEGE has been noted for many years as the sponsor of a combined theoretical and practical training system, essentially its own, which should constitute a good preparation for the administrative side of engineering. It has now extended this to include aeronautical engineering, and offers a course that should appeal to a type of man not very largely catered for at the present. The combined lectures, workshop, and aerodrome practice, constitute a four-year course leading to the College diploma and the Air Ministry's ground engineer's licences. A fifth year qualifies for an honours diploma, and covers the syllabus of the examinations of the Royal Aeronautical Society. The instruction comprises lectures and laboratory work, sandwiched with work in the production engineering workshops, on alternate weeks. The training is general during the first two years, but in the third and fourth year the practical work is entirely aeronautical, including aircraft rigging, maintenance, sheet metal work, engine repairs and testing. Flying instruction is also

given during that period. The fifth year covers the more advanced side of aircraft and engine design, or alternatively advanced flying up to the standard required for a pilot's *B* licence. The teaching is carried out by the college engineering staff, with the addition of three special aeronautical instructors.

THE education of Negroes formed the subject of a national conference held in Washington under the auspices of the United States Federal Office of Education in May 1934. A preliminary report has now been published, as Bulletin No. 6 of 1935 of the Federal Office, under the title "Fundamentals in the Education of Negroes". The title, suggesting, as it does, differentiation between the principles of education applicable to Negroes and those applicable to whites, is rather misleading. The purpose of the conference was to determine what are the fundamental requirements for raising the standard, both quantitative and qualitative, of education of Negroes up to the level of the education of whites. One of the conclusions reached is that the southern States are not able to provide public education for all children on an equal basis with the other sections of the country, and another is that glaring inequalities exist in the expenditures of school funds for the benefit of Negroes and whites respectively. Eleven southern States spent, in 1930, 35½ dollars per pupil in all schools but only 12½ dollars per pupil in Negro schools; moreover, 64 per cent of the Negro schools were one-teacher schools. Associated, both as cause and as result, with the inadequate provision of schooling for Negro children, is the fact that more than half of all American Negroes live in the open country or in villages.

IN "Science and the New Humanism", a series of articles contributed to the Workers' Educational Association's monthly, the *Highway*, Prof. L. Hogben, of the London School of Economics, outlines a field of study which he commends to the Adult Education Movement as one that offers an opportunity for work of the utmost national importance. The "Retreat from Reason", so ominously apparent among the younger generation in this as in other countries, he attributes to a dualism in educational politics, a cleavage between the education of scientific workers and technicians on one hand and of leaders and administrators on the other. This dualism, again, is a result of failure to adjust educational policies to the changes wrought in the structure of society by the enormous advances in the applied sciences. It is urgently necessary to devise methods of education which will give the community representatives who can co-operate intelligently with technical experts in constructive social enterprise at present suffering from paralysis as a result of educational dualism. In the first of his articles, Prof. Hogben exposes some of the faults of method that stultify current unscientific social 'science' doctrine. He quotes passages from the new humanistic studies making a fetish of mere logic, reducing their work to the level of a game of chess. Much, also, is sacrificed, he shows, to the idol of purity, so that a social inquiry which tends to the conclusion that something has to be done is said to be "tendencious", as if researches of a worker in natural science should be deemed worthless if there were grounds for suspecting the researcher of *wanting* to get a particular result, or an investigator is looked askance at for poaching on the preserves of investigators wearing a different subject label.

# Science News a Century Ago

### Lambeth Literary and Scientific Institution

ON April 12, 1836, a series of weekly lectures began at the Lambeth Literary and Scientific Institution, Wellington Terrace, Waterloo Bridge Road. The first and fourth of the lectures, by W. M. Higgins, were on electricity; in the second, third and sixth Dr. Lardner dealt with the principles and structure of the steam engine and its application to railroad and to navigation, while the fifth of the series was on the eye, the theory of vision and optical illusion, and was given by W. C. Dendy.

### Petroleum and Titanium at Coalbrookdale

IN a paper on the physical features, geological structure and organic remains of the Coalbrookdale district, read to the Geological Society on April 13, 1836, Prestwich said that the petroleum or tar spring, for which Coalbrookdale has been so long celebrated, issues from a thick bed of sandstone, in the upper part of the coal measures: it yielded formerly more than a hogshead a day, but produces now only a few gallons a week. Another spring had been discovered, and petroleum is frequently found to some extent in working the coal. Titanium has been produced in considerable abundance in the iron furnaces. It often occurs in crystals of great beauty, but principally in amorphous masses. On examining some portions of hearth stones belonging to a furnace which had been at work for nine or ten years he discovered lumps of titanium as large as a marble cemented by a small quantity of iron.

### Death of James Horsburgh

ON April 14, 1836, the eminent British seaman and hydrographer James Horsburgh died at the age of seventy-three years. Horsburgh was born at Elie in Fifeshire on September 23, 1762, of poor parentage. He learned elementary mathematics at school, and at fifteen years of age became an apprentice in a collier brig employed in the North Sea. In 1780 the vessel in which he was serving was captured by a French frigate, and Horsburgh was for a time a prisoner at Dunkirk. Regaining his liberty, he sailed for the East, and while first mate of an East Indiaman turned his attention to hydrography, teaching himself to draw and engrave. His voyages took him to China, Batavia and New Guinea, and some of his sailing directions and charts were published by the East India Company. Returning to England in 1796, his reputation gained for him the friendship of Banks, Maskelyne and Cavendish, but after a short stay at home he sailed again for the East, continuing his scientific observations. Back in England in 1806, he was admitted a fellow of the Royal Society, and in 1809 was appointed hydrographer to the East India Company in succession to Alexander Dalrymple. Few men contributed more to the safety of navigation in Eastern waters than Horsburgh.

### On the Temperatures of Hot Springs

AT a meeting of the Royal Society held on April 14, 1836, Prof. J. D. Forbes concluded the reading of his paper "On the Temperatures and Geological Relations of Certain Hot Springs; particularly those of the Pyrenees; and on the Verification of Thermometers". He expressed his regret that notwithstanding the great interest of the subject, information on

the thermal phenomena was very deficient. After describing his own observations made in the Pyrenees in July and August 1835, in the last section of his paper he extended his inquiries to the hot springs met with in other parts of Europe; and in particular, those of the baths of Mont d'Or and of Bourboule, in France; of Baden-Baden, in Germany; of Loèsche or Leuk, in the Vallais; of Pfeffers, in the canton of St. Gall, in Switzerland; and the baths of Nero, near Naples. Tables of observations were given with comparative columns derived from unpublished observations of Arago and Anglada.

### Geology of Scotland

ACCORDING to the *Edinburgh Philosophical Journal*, at a meeting of the Wernerian Society held on April 16, 1836, "A notice was read on the dolomisation of the marble limestones, showing their magnesian character. The author also stated his views in regard to the geognostical relation of the Plutonian rocks of Skye, which he referred to the porphyry and trap formations. . . . The blunders in observation, and the wholesale appropriation to himself of the geology of Scotland (in despite of all the published and unpublished accounts of Scottish, English and German geologists) by Dr. MacCulloch, were noticed; and it was remarked by several members, that a better spirit was now generally abroad, and that few were disposed to follow in the path of the author of the Hebrides".

## Societies and Academies

### PARIS

Academy of Sciences, March 2 (*C.R.*, 202, 705–784). The president announced the deaths of Charles Nicolle and Ivan Pavlov. ERNEST ESCLANGON: The formulæ of Lorentz, and the principle of relativity. LUCIEN CUÉNOT: The coaptation of the anterior feet and of the head in *Phasma*. EDOUARD CHATTON and MLLE. SIMONE BRACHON: The cinetome of *Opalina ranarum*, its genetic continuity and its importance with regard to the evolution of the ciliary apparatus. JOS. KAUCKY: The problem of iterations in a case of dependent probabilities. EDGAR BATICLE: The problem of encounters. ALEXANDRE OSTROWSKI: The conservation of the angles in the conformal transformation of a domain in the neighbourhood of a boundary point. GEORGES HARTMANN: Certain properties of a Grassmanian. CHARLES CHARTIER and JEAN LABAT: The application of stereoscopic chronophotography to the kinematic study of gaseous outflow. HENRI LEMONDE: The interpretation of diffusion and viscosity curves in binary mixtures. PIERRE VERNOTTE: The general laws of natural convection. Conditions for the appearance of the first regime. D. MILOSSAVLIÉVITCH: The use of the electronic tube as a detector utilising the curvature of the grid characteristic. ALEXANDRE DAUVILLIER: A photomagnetron and its application to the measurement of twilight illuminations. P. CARRÉ: A practical rule leading to the interpretation of certain reactions of organic chemistry from the electronic point of view. L. NÉEL: The theory of volume anomalies of ferromagnetic substances. HENRI TRICHÉ: The spectrographic study of the modifications undergone by the surface of the light alloys. Application to duralumin. CONSTANT CORIN: The infra-red absorption spectra of the chlorine derivatives of methane. JEAN ROULLEAU: The influence of temperature on the photo-electric effect of cuprous oxide-metal contact. The anomalies presented by the temperature coefficient of the photopotential are only apparent, and it is possible to define a temperature coefficient with constant contact resistance which depends only on the temperature and not on the cell studied. MAURICE CURIE: The theories of phosphorescence. The theory of Muto, based on the existence of a metastable state of the foreign atom, can be applied in the simplest cases, but other experimental facts have to be taken into account. RAYMOND LAUTIÉ: The molecular volume of normal liquids. ALBERT MICHEL-LÉVY and HENRI MURAOUR: The influence of the pressure of the surrounding gas on the luminosities accompanying the detonation of explosives. Increase of pressure of the surrounding gas considerably diminishes the intensity of the luminous phenomena, when lead hydrazoate is the explosive. Three photographs are reproduced illustrating the effect of changing pressures. NÉDA MARINESCO: The law of blackening of photographic plates by ultra-sounds. The blackening by ultrasounds follows a law analogous with that of Hurter and Driffield. The results show that the photochemical action of light and that of ultra-sounds are identical. MARCEL GODCHOT, MLLE. GERMAINE CAUQUIL and RAYMOND CALAS: The deuterhydrates of krypton and xenon. Forcrand showed that krypton and xenon can form hydrates with water containing approximately $6\,H_2O$. The hydrates formed with heavy water are found to have the same composition. PAUL BRASSEUR: The study of the anhydrous ferric phosphates with X-rays. Four varieties of ferric metaphosphate give the same X-ray diagram. Ferric pyrophosphate gave a different diagram, but no diagram characteristic of Millot's pyrophosphate could be obtained. PIERRE SÜE: The dehydration of some sodium niobates. EDOUARD RENCKER and MARC BASSIÈRE: The allotropic varieties of lead oxide. Lead oxide exists in two states ($\alpha$ and $\beta$) characterised by their Debye and Sherrer diagrams. The thermal transformation of the $\alpha$-oxide into the $\beta$-oxide takes place suddenly at 530° C. MORICE LETORT: A new polymer of acetaldehyde. The polymer recently described by Travers was noticed by the author in 1933, while preparing some highly purified acetaldehyde. Its properties agree with those given by Travers. One reaction in addition is given; the polymer reacts violently with fuming nitric acid and some nitrobenzene is produced. MARTIN BATTEGAY and PIERRE BOEHLER: The salts of $\alpha$- and $\beta$-anthracenyl-diazonium. PIERRE COMTE: The lower Devonian of Léon (Spain). ROBERT LAFFITTE: The Jurassic and Berriasian in Aurès (Algeria). ANDRÉ EICHORN and ROBERT FRANQUET: Chromosome enumeration and the study of somatic mitosis in *Asclepias cornuti*. SERGE TCHAKHOTINE: The effects of localised irradiation of the nucleus of Infusoria by ultra-violet micropuncture. ERNEST KAHANE and MLLE. JEANNE LÉVY: The diastatic hydrolysis of acetylcholine by serum.

### AMSTERDAM

Royal Academy of Sciences (*Proc.*, 39, No. 2, February 1936). F. K. TH. VAN ITERSON: Cavitation and surface tension. Studies to determine the cause of the erosion by cavitation of the pumps used in draining the Zuider Zee. W. H. KEESOM and P. H. VAN LAER: Relaxation phenomena in the transition

from the supraconductive to the non-supraconductive state. There is a relaxation time of 10–40 sec. when the threshold curve is crossed by raising the temperature in the presence of a magnetic field. W. H. Keesom and K. W. Taconis: Crystal structure of solid oxygen. Confirmation of Vegard's results. J. G. van der Corput: Distribution functions (5). E. Cohen and J. J. A. Blekkingh, jun.: Influence of the degree of dispersion on physico-chemical constants (6). An effect of the degree of dispersion on the solubility of salicylic acid is observed. F. M. Jaeger and J. A. van Dijk: Complex salts of dipyridyl with bivalent and trivalent cobalt. A. A. Nijland: Mean light curves of long-period variables, 26.$V18 = RZ$ Persei. This star has a complicated light curve with a main period of 354 days. P. H. van Cittert: Some remarks on the resolving power of the microscope measured with Grayson's rulings. Influence of the kind of illumination on the resolving power. L. Hulthen: The antiferromagnetic exchange problem at low temperatures. Calculation of the entropy and susceptibility. P. J. Haringhuizen and D. A. Was: Research on thin layers of tin and other metals (2). The corrosion of metals by technical insulating oils. Results for tin, lead and copper. W. Hurewicz: Contributions to the topology of deformations (4). Aspherical spaces. J. F. Koksma: Metrical considerations in the theory of diophantine approximations. J. Beintema: Crystal structure of magnesium and nickel antimonate. The formulæ of both of these compounds is shown to be $\{M(H_2O)_6\}\{Sb(OH)_6\}_2$. Ida Luyten: Vegetative cultivation of species of *Hippeastrum* (2). M. H. van Raalte: Influence of glucose on auxin production by the root tip of *Vicia Faba*. S. de Boer and H. H. J. Holtkamp: Effect of medicines on auricular fibrillation (1). Experimental researches on the influence of hydroquinine, hydroquinidine, quinine and hydroquinidine-free quinidine on auricular fibrillation of cats. B. van der Eyken: Denture and teeth development in the irisforelle (*Salmo irideus*) (3). Upper jaw. P. B. van Weel: The periodicity in the metabolism of the recuperating pancreas of the white mouse. Elisabeth A. Rietmeyer and F. J. Nieuwenhuyzen: The action of guanidine derivatives on motility. C. D. Verrijp and E. F. Drion: Frequency distribution of growth in homogeneous material (1). Experiments on *Kalanchoë verticillata* considered in relation to statistical theories of Pearson, Kapteyn and others.

### Cracow

**Polish Academy of Science and Letters**, February 5. W. Sierpinski: A universal function of two real variables. S. Ruziewicz: Remark on universal functions of two real variables. L. Jansons: The Zeeman effect of the forbidden lines of the helium spectrum. T. Banachiewicz: A new minor planet. This planet was discovered on plates taken at Cracow by K. Stein on January 24, 1936, and the position is given. It is possible that this planet may prove identical with the planet 1936 *AB*. K. Dziewonski, T. Majewicz and L. Schimmer: New studies on the bisubstituted derivatives of naphthalic acid. B. Hryniewiecki and Mlle. W. Kurtz: The distribution of the siliceous cones in the cells of the Cyperaceæ and their correlations. J. Motyka: A monograph of the genus *Usnea*. H. Szarski: Contribution to the study of the physiology of the worms included in the genus *Chætogaster*. J. Zacwilichowski: Researches on the innervation of the sensorial organs in the wings of *Aphrophora alni*. J. Tur: A double neoplastic embryo. P. Slonimski: The figured elements of the blood of *Amphiuma means*.

### Geneva

**Society of Physics and Natural History**, February 6. E. Guyenot, E. Held and A. Moszkowska: (1) Habituation to prehypophysal hormones. (2) The production of anti-hormones in the serum of habituated animals. Female guinea pigs, after prolonged treatment with prehypophysal extracts, become refractory to the action of these hormones. Experiments prove that this is the result of the production of anti-bodies, present in the serum and capable of conferring a passive immunity on fresh animals. A. Jayet: Some new observations on the Magdalenian of Veyrier sous Salève (Hte. Savoie). A. Perier: Various anatomical types of the tubercle of Carabelli. W. H. Schopfer and A. Jung: Researches on the measurement of vitamin $B_1$ activity with the aid of a micro-organism (*Phycomyces*). A certain number of substances, known for their content of vitamin $B_1$, are examined simultaneously with the test animal (rat) and plant (*Phycomyces*). The results are partially satisfactory. If, in a concentrated extract, the vitamin $B_1$ is the only effective factor, the plant test is susceptible of practical applications, at any rate in certain cases.

February 20. A. Lendner: Hereditary 'alcoholism' in the bean (*Phaseolus vulgaris*). Ch. Baehni: A new genus of the family of the Icacinaceæ, Neoloretia. B. Susz and E. Perrottet: The Raman spectrum of isoeugenol and of the safrol series.

### Moscow

**Academy of Sciences** (*C.R.*, **4**, No. 4–5; 1935). L. V. Kantorovitch: Some particular methods of prolongation of Hilbert space. A. Tichonov: Mathematical theory of the thermo-electric couple. V. Fabrikant, F. Butajeva and J. Ciro: Influence of pressure on the discharge radiation in mercury vapour. A. V. Solovjev: (1) Effect of the water vapour pressure on the rate of the interaction between iodine and metals (iron and copper). (2) Interaction between aluminium and iodine in an air atmosphere of varying humidity. A. Polessitskij: Solubility and activity of the halogenates of some bivalent metals. (1) Solubility and activity of $Ba(IO_3)_2$ in water and in solutions of electrolytes. (2) Solubility and activity of $Pb(IO_3)_2$ in water and in solutions of electrolytes. K. S. Topcijev: Cases of mobility of the nitro-group. A. Vedenejeva, S. Grumgrzimajlo and A. Volkov: Microscopic determination of the refractive indexes of resinous substances of highly refractive minerals. Z. Katznelson: Sources of development of the lateroventral part of the trunk muscles and the caudal muscles in Amphibia. The muscles develop from the mesenchyme. A. J. Charite: Flavins and metabolism. (1) Flavins and amylolysis. (2) Flavins and proteolysis. S. I. Krajevoj and R. A. Rassuly: Frequency of translocations in different sections of the chromosome in *Pisum*. A. F. Buchinskij: Inheritance of duration of vegetative period in tobacco. V. I. Krokos: Stratigraphy of the quaternary deposits of the south-western portion of the ice lobe in the Don River basin.

ROME

Royal National Academy of the Lincei (*Atti*, 22, 1–91; 1935). G. A. CROCCO: Safety of gliders on encountering an ascending gust. P. ALOISI: Some flint-stones of anagenite-verrucano from Monte Pisano. L. TOSCANO: Permutable operators with the power of a special linear operator (2). L. ERMOLAEF: Surface couples with corresponding asymptotes and having a pair of common conjugate straight lines at homologous points. A. TONOLO: Integration of the differential system of Dirac. R. WOINAROSKY: Kinematics of a solid body in Euclidean space of *n* dimensions. N. SPAMPINATO: Extension to the bicomplex field of two theorems of Levi-Civita and of Severi, through the holomorphous functions of two complex variables (1). G. SCORZA DRAGONI: Some theorems relative to a problem of limits through a differential equation of the second order. G. MATTIOLI: Internal forces in turbulent media and general equations of turbulence. D. GRAFFI: Effect of variation of mass on a planetary orbit. N. W. AKIMOFF: The paradox of Dubuat. C. M. MALDURA: Chemical researches on the Orbetello lagoon with regard to the biology (1). A. SPIRITO: Influence of continuous electric current on meristems of roots. G. SCHREIBER: Atypical regeneration of the limbs of *Proteus anguineus*, Laur. M. ROMANO and G. SCHREIBER: Changes of the eye of Anurans during normal and accelerated metamorphosis. V. FAMIANI: Anti-neuritic vitamin ($B_1$) content of germinating grain, and of some varieties of Italian grain. T. DE SANCTIS MONALDI: Experimental human malarial infection from sporozoites.

VIENNA

Academy of Sciences, February 20. RICHARD SCHUMANN: Report on further investigations of latitude variations. OTTO DISCHENDORFER and AUGUST VERDINO: Condensation of benzoin and thymol (1). Preparation of 2-benzoyl thymol and determination of the constitution of desyl thymol. JOSEF A. PRIEBSCH: Study of the secondary radiation of cosmic rays at 2,300 m. by counters. The number of coincidences recorded at high altitude by three counters arranged in a triangle below a sheet of scattering material varies more with barometric pressure, temperature, and time of day than either the total or the vertical radiation. ELISE HOFMANN: A silicicated palm in the Tertiary at Retz (Austria). ERNST MELAN: Theory of statically indeterminate systems made of ideally plastic material. GERHARD HEINRICH: Theoretical and experimental study of the water-jet suction pump. R. JAGITSCH: Reactions in the solid state. E. HAYEK: Crystallisation and dehydration of copper hydroxide. ODOMAR GUGENBERGER: (1) The Trias at Eberstein (Carinthia). Ninety further species have been distinguished in the fauna of the *Cardita*-bearing stratum at Eberstein. Of these, fifty-nine have previously been found in the related Launsdorf deposits, while of the remainder nine are entirely new. (2) Unknown species in the sub-Lias (Buckland zone) of the province of Palermo.

February 27. KARL GIRKMANN: Yielding of tie rods under local loads. F. WESSELY, K. SCHÖNOL and W. ISEMANN: The bitter principle of Columbo wood. HERBERT SCHOBER: Study of the spectra of the inert gases by means of a short wave generator.

# Forthcoming Events

CHEMICAL SOCIETY, April 16–17.—Anniversary Meeting to be held at Bristol.

April 16, at 4.45.—Presidential Address. Dr. N. V. Sidgwick.

April 17, at 11.30.—Prof. T. S. Moore: Hatzsch Memorial Lecture.

GEOGRAPHICAL ASSOCIATION, April 17–20.—Spring Conference to be held in the University of Sheffield.

BRITISH PSYCHOLOGICAL SOCIETY, April 17–20.—Extraordinary General Meeting to be held in Leeds.

# Official Publications Received

## Great Britain and Ireland

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council. By H. Dent Gardner; with Meteorological Notes and Tables for the Year 1935, also Additional Meteorological Tables for the Lustrum 1931–1935, with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 17. (Falmouth: Falmouth Observatory.) [193

The Board of Greenkeeping Research. Report for 1935. Pp. 54. (Bingley: St. Ives Research Station.) [203

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 31: The Preparation of Alginic Acid and its Constitution. By Vincent C. Barry and Dr. Thomas Dillon. Pp. 285–287. 6*d*. Vol. 21 (N.S.), No. 32: Derivatives of Alginic Acid, Part 1: The Acetylation of Alginic Acid. By Vincent C. Barry, Dr. Thomas Dillon and Pádraic O'Muineacháin. Pp. 289–296. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [253

## Other Countries

Indian Forest Records. New Series, Vol. 1, No. 11: New Indian Curculionidae (Col.). By Sir Guy A. K. Marshall. Pp. 205–232. (Delhi: Manager of Publications.) 1 rupee; 1*s*. 9*d*. [163

Education, India. Education in India in 1933–34. Pp. vii+127. (Delhi: Manager of Publications.) 2.2 rupees; 4*s*. [233

Ministry of Finance, Egypt: Survey of Egypt: Geological Survey. Leaves of Dicotyledons from the Nubian Sandstone of Egypt. By Prof. A. C. Seward. Pp. iii+23+3 plates. (Cairo: Government Press.) [233

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 15, No. 3: Additional Cretaceous Plants from Western Greenland. By A. C. Seward and Verona Conway. Pp. 41+6 plates. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [233

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 133: Experimentelle Untersuchungen über Augen-Blendung. Von Yenziro Awadi. Pp. 60. 55 sen. No. 134: On the Directional Properties of Airscrew Sound. By Jûichi Obata, Yahei Yosida and Umezirô Yosida. Pp. 61–79. 35 sen. (Tokyo: Kôgyô Tosho Kabushiki Kaisha.) [233

Indian Forest Records, New Series. Vol. 1, No. 2: Experiments on the Air Seasoning of Softwood Railway Sleepers. By Dr. S. N. Kapur, assisted by Azizul Rehman. Pp. iv+43–75+2 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s*. [233

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, Vol. 26, Part 8: New Species of Piles from the Andes. By Ellsworth P. Killip. Pp. viii+367–394. (Washington, D.C.: Government Printing Office.) 10 cents. [233

Smithsonian Miscellaneous Collections. Vol. 95, No. 1: Observing the Sun at 19,300 feet Altitude, Mount Aunconquilcha, Chile. By C. P. Butler. (Publication 3379.) Pp. ii+4. Vol. 94, No. 17: Growth of a Green Alga in Isolated Wave-Length Regions. By Florence E. Meier. (Publication 3377.) Pp. ii+12+1 plate. (Washington, D.C.: Smithsonian Institution.) [233

U.S. Department of Agriculture. Technical Bulletin No. 486: Cotton Boll weevil Survival and Emergence in Hibernation Cages in Louisiana. By R. C. Gaines. Pp. 28. 5 cents. Technical Bulletin No. 499: The Cannibalistic Habits of the Corn Ear Worm. By George W. Barber. Pp. 19. 5 cents. Technical Bulletin No. 502: The Chemical and Physical Properties of Dry-Land Soils and of their Colloids. By Irvin C. Brown and Horace G. Byers. Pp. 56. 10 cents. (Washington, D.C.: Government Printing Office.) [233

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 2: Statistics of Private Elementary and Secondary Schools, 1932–33. (Being Chapter 6 of the Biennial Survey of Education in the United States, 1932–34.) Pp. 71. (Washington, D.C.: Government Printing Office.) 10 cents. [233

## Catalogues

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 8, March. Pp. 97–110+iv. (London: Wild-Barfield Electric Furnaces, Ltd.)

Radiography and Clinical Photography. Vol. 1, No. 1. Pp. 8. (London: Kodak, Ltd.)

Vitreosil (Pure Fused Quartz or Silica Ware) for use in Chemical and other Laboratories. Pp. 58. (Wallsend-on-Tyne: The Thermal Syndicate, Ltd.)

A Complete List of Chapman and Hall's Scientific and Technical Books. Pp. 168+xxxviii. (London: Chapman and Hall, Ltd.)

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# The Delusion of Race

RACE classification, it has been asserted by an authority of no little experience, is the most difficult of the tasks of the anthropologist. The difficulties of the man of science in connexion with a technical point are not, as a rule, of immediate concern outside professional circles; but in this instance the inability of the anthropologists to clarify opinion by a generally acceptable definition of 'race', and their failure to arrive at an agreement as to its implications have had serious repercussions in the outside world, as is now familiar to everyone. Extreme and biased views have been accepted as endorsed by science because no voice is raised to contradict them with full and unquestioned authority.

It is unfortunate that striking distinctions between peoples and between individual members of population groups, which are immediately obvious, should afford ground for popular judgment on questions of race, upon which the anthropologist, with full technical equipment, hesitates to arrive at a final conclusion. It is still more unfortunate that, so far from the disparity between the hesitancy of science and the dogmatic certainty of popular opinion being a matter of merely academic interest, up to the present the popular judgment has prevailed in practical affairs. Racial distinctions have emerged from the sphere of intellectual inquiry and have been made the practical basis of discrimination and a justification for actions such as social ostracism, legal disability and group persecution which have brought disaster to society and the individual throughout the whole course of history.

It is, of course, patent to anyone familiar with the analytic methods of the scientific study of peoples and population groups that the popular judgment in racial matters is in fact based on a composite body of evidence. It is usually initiated by the stimulus of certain obvious and distinctive physical characters exhibited in the individual. More often than not, one character only is taken into account, such as colour; and this is reinforced and confirmed by the interpretation of other characters, which the more precise diagnosis of science assigns to the influence of one or other of at least three factors—race (in the sense of the inheritance of certain physical characters and also, presumably, certain mental qualities, though on the latter most anthropologists would hesitate to dogmatise), environment and culture. Of the two latter, one stands for the physical conditions, the other for the social and material circumstances in which the individual organism has developed and by which it has been moulded while plastic.

The precise determination of the respective spheres of the influence of the three factors—race, environment and culture—is often difficult to discern; but owing to the failure of the popular judgment to discriminate, even on broad lines, between the parts played by them in the life-history of the individual and the group, there arise such popular confusions as that between nationality and race, as in the fallacy of the 'French race', or between linguistic affinity and race, which is responsible for the 'Latin races' and the 'Celtic race', or in the mistaken identification of a cultural quality as racial, as for example colour preference in dress, or even gesture or intonation in speech.

However much the more instructed observer may attempt to discount their influence, there is no doubt that cultural characters play a large, but not always consciously realised, part in racial identifications, which do not depend upon exact

measurement. The conscientious anthropologist, however, would hesitate to say at present whether or not some of such cultural characters may have a diagnostic value in racial discrimination, in a broad sense, between discrete groups—in other words, how far, if at all, culture is a function of race. A priori argument might well maintain that a specific culture is as much a product of the discriminatory process of natural selection as the evolved race by which it has been developed.

The difficulties of the problem, of which not a tithe of the more obvious are here suggested, may be gauged from the fact that a committee of the Royal Anthropological Institute and the Institute of Sociology, appointed in April 1934 to frame a simple definition of race to serve as a guide to the general public in the discussion of the problems of to-day and to indicate the relations of race and culture, has only now reached the stage of an interim report* dealing with the definition of race. The committee had for chairman Sir Grafton Elliot Smith and later Prof. H. J. Fleure. Its members are distinguished anthropologists and biologists, and include Profs. J. B. S. Haldane, Ruggles Gates and Le Gros Clark, and Dr. G. M. Morant. Even after this term of deliberation, which it may not be regarded as unfair in the circumstances to designate 'lengthy', the committee was not able to arrive at complete agreement. Not only are alternative definitions offered, but also several members append independent observations which at times almost amount to minority reports.

The definition of race put forward by the committee is as follows:

"A Race is composed of one or more interbreeding groups of individuals and their descendants, possessing in common a number of innate characteristics which distinguish them from other groups. The innate characteristics mentioned are held to be such as usually apply to the generality of the individuals studied, and not to be pathological characters, or features (such as red hair) which characterise only a relatively small percentage in a population. In the present state of our knowledge we are dependent on characters recognised as physical for the purpose of differentiating races, though innate psychological characters may later be found to differentiate them."

The alternative definition preferred by some members is:

"By race is meant a biological group or stock possessing in common an undetermined number of associated genetical characteristics by which it can be distinguished from other groups and by which its descendants will be distinguished under conditions of continuous isolation (that is, so long as the stock is preserved against internal dilution)."

* Race and Culture. Pp. 24. (London: Le Play House Press; Royal Anthropological Institute, 1936.) 1s.

These definitions are unexceptionable, each in its respective field and so far as it goes. The second is perhaps to be preferred, as it brings the study of man more nearly into relation with the present trend of biological research in other fields. In view, however, of the special purpose of the committee to provide assistance for the general public in current discussion, certain limitations might have been pointed out. In so far as the races of man are concerned, these definitions, far from being generalisations from concrete realities and empirical, are no more than logical concepts, postulated for purposes of classification and investigation. In face of the actual facts of the distribution of physical characters among the population groups of the world, as they exist at the present moment, race is a pure abstraction. The races or types into which the anthropologist groups the varieties of *Homo sapiens* are ideal types built up to explain congeries of characters in individuals and groups, derivative from a variety of strains, in some sort of a phylogeny. Man seems to be almost infinitely variable within a wide range, and since upper palæolithic times in the course of world-wide migration has interbred freely, with the result that the ideal types of anthropological classification, if they ever existed at all in any degree of purity, have become a matter of faith rather than of evidence. Characters on which classifications have been based are found everywhere to overlap, and both individual and population group bear witness to their inextricably mixed descent.

Modern facilities of transport have naturally added considerably to the trials of the anthropologist. Some indications of the combinations in breeds and the complicated character of the results within a comparatively short period is afforded by conditions in South Africa, of which an interesting account is given in a study of some racial crosses to be seen there by Prof. H. B. Fantham, now of McGill University and formerly professor of zoology in the Witwatersrand University, Johannesburg (see p. 665). In South Africa, as has been shown by recent discussion of the native 'Cape franchise' in the Union Parliament, the racial question is acute. It has the somewhat peculiar feature that the policy of segregation adopted by the white population as a protective measure against the

domination of the black by force of numbers, is also strongly supported by the latter, or at least its better elements. On both sides there is a fear of racial deterioration and degradation. It is interesting, therefore, to see what are the actual results of some of the crossings which have come under Prof. Fantham's observation.

A family which arose from a Dutch-Xosa miscegenation, repeated by one son, while other children married 'Cape coloured', consisted of fifteen individuals in two generations, who varied from black to three members who pass as white. The hair varied from frizzy or crimpy to fairly straight. The white members are described as "more temperamental". Another family, also of Dutch-Xosa origin, investigated in three filial generations, shows the same variation in pigmentation, feature and hair form between the European and the black parent; while the most marked range of variation is shown, as might be expected, by the intermarriage of two families, who had a mixed descent of Portuguese, Dutch, Huguenot, Basuto and Javanese (Malay).

The interest of these studies, of course, is that they are a precise and exact record of a state of affairs which is known to have been in being since the sixteenth century, when the whites first began to come in numbers to the Cape. Further, the native peoples with whom the whites intermarried were not themselves 'pure'. Not only had they interbred freely, or at least with some freedom, but also some of them had been in contact with Arabs and other early visitors to Africa.

South Africa, however, is not singular in this matter of racial crossing, though the facts can perhaps be followed there with greater certainty than in some other parts of the world. The conditions there, in fact, reproduce what has been taking place on a greater or lesser scale in all parts of the world since man first began to move about at all freely. The remarkable results noted by Prof. Fantham and the records of other observers go to show how it has come about that individuals and populations, when submitted to detailed examination, exhibit combinations of characters which set precise classification at defiance, if more than a very limited range of characters is taken into account. This fact certainly lends every support to those who would maintain that the significance attached to race in current political argument is a delusion which, in its inflammatory tendencies, is fraught with no little danger.

# The Art of Plant Description

**Phytography as a Fine Art:**
Comprising Linnean Description, Micrography and Penportraits. By Dr. J. W. Moll. Pp. xix + 534. (Leyden: E. J. Brill, Ltd., 1934.) 15 guilders.

THE late Prof. Moll's book on phytography is remarkable in several respects. Written between the ages of seventy-two and eighty-two years by a blind man suffering from gradually increasing deafness, with the aid of three successive secretaries and the use of Braille, it represents a triumph of human will-power and endurance over grave bodily disabilities. The subject of the work is stated to be the improvement of the art of phytography in all possible directions. The book actually consists, however, of a highly complex morphological system by the aid of which a fairly adequate description may be drawn up in a more or less mechanical way, even by a botanist who possesses little or no natural aptitude for the task. The system is valuable also to the skilled describer, since it may frequently serve as a reminder to include essential characters which might otherwise be easily overlooked.

The monumental nature of this system is illustrated by the author's statement that "a complete pen-portrait of a higher plant will easily take a man's work during a whole year". On this basis, the completion of a work comprising the pen-portraits of all known plants would cost at least 150,000 years of a man's working life: even with 1,000 collaborators it would still take 150 years. This amounts to an impossibility, and it seems clear that the description of the plant world will continue to proceed largely by means of those approximately accurate generalisations regarding taxonomic groups commonly called 'descriptions' of sections, genera, tribes, families, etc. Indeed, one of the earliest lessons that the budding taxonomist should learn is to exclude well-established generic characters from his specific descriptions.

The volume is divided into five 'books', the first (pp. 3–22) being introductory. The value of the

'Linnean method' of description is shown to reside in its terse style, relatively complete enumeration of members of the plant body, and the rigorous order of succession in which they are described. This simplifies the comparison of descriptions. The Linnean method was extended to micrographical descriptions by Moll in 1907, and was further developed in this direction by Moll and Janssonius in 1923. The art of plant description, as expounded by Moll, rests on two essentials: "a fixed universal and rational terminology, based on General Morphology"; and "the use of guiding schemes for facilitating the work of description and raising its efficiency". These are included in Book 2 (pp. 25–462), together with a series of morphological notes dealing with difficulties or controversial points. The third 'book' (pp. 463–479) contains "Results of the application of the method of pen-portraits in phytography and . . . other sciences", while the fourth (pp. 481–495) and fifth (pp. 497–523) deal respectively with "Education in Phytographical Methods" and "The Distribution of the Subject Matter in Text-books".

The "Synopsis of General Morphology" included in Book 2 is actually a collection of about 2,500 botanical terms, treated in 751 articles connected by cross-references. The article on transverse æstivation (p. 156, S. No. 263) may be taken as an example. It starts with a dichotomy between the open and closed types of æstivation, the latter being again divided into the "valvular or valvate" and the "imbricative or imbricate" modes. Under valvular æstivation are the induplicate, reduplicate and involute modifications. Imbricative æstivation is divided into six kinds, namely, quincuncial, cochlear, contorted, equitant, vexillary or descendant, and ascendant. Here the system is defective: quincuncial and cochlear æstivation are special types applying only to whorls consisting of five parts each, and therefore do not contrast properly with the contorted type, which may apply to whorls consisting of any number of parts from two upwards. Furthermore, the cochlear arrangement, as defined by Moll, includes two separate types, in one of which the single outer and inner members are adjacent, while in the other they are separated (*v. J. Bot.*, 56, 210; 1923). The corresponding guiding scheme (p. 407, No. 34) is on the same lines. The experienced systematist will be able, however, to make such modifications as may be required in this and other schemes.

The guiding schemes for general and special histology form perhaps the most valuable part of the book, since they afford a much-needed framework for systematic descriptions of anatomical characters. In Solereder's "Systematic Anatomy of Dicotyledons", "we seek in vain for anything like a regular method of micrography". The scheme for the "histological determination and description of emissaries (hydathodes)", being comparatively short, may be given as an example, the various degrees of indentation in the original table being indicated below by means of the punctuation.

1*a*. epidermal emissaries: 2*a*. ordinary emissaries: 3*a*. unicellular; 3*b*. pluricellular—2*b*. trichome emissaries.

1*b*. emissaries provided with the ends of xylem bundles: 2*a*. water-pores wanting: 3*a*. excreting cells; 3*b*. ends of xylem bundles—2*b*. water-pores present: 3*a*. water-pores: 4*a*. number and arrangement; 4*b*. shape (see guiding scheme No. 71)—3*b*. epithema; 3*c*. ends of xylem bundles—2*c*. apical openings: 3*a*. cuticle; 3*b*. cavity; 3*c*. ends of xylem bundles.

Moll was perhaps less at home in the description of macroscopic characters. Thus his inclusion of "lanceolate" (p. 430) among those shapes with the greatest breadth in the middle part is not in accordance with modern practice, although it conforms with the Linnean definition. Sometimes, however, his departures from orthodox terminology constitute an improvement, as in the case of pedicel (pedicellus) defined as "the special and relatively small stalk of a single flower", whether this flower is solitary or forms part of an inflorescence. This seems more logical than the usual restriction of the term to the final axes in an inflorescence. His definition of a rhizome as a metamorphosed caulome or cormus directs attention to the fact that the lateral phyllomes are included under the term rhizome only when they are reduced to scale-leaves: in fact, a rhizome, as commonly defined, is not a single morphological entity. Four types of marginal indentation of a phyllome are very neatly defined by means of the obtuse or acute nature of the angles and of the sinus, a dentate margin, for example, resulting from the combination of acute angles with obtuse sinus, and a crenate one corresponding with obtuse angles and acute sinus.

In addition to its chief purpose as a handbook for plant description, Moll's "Phytography" forms a useful guide to general morphology. This part of the work was compiled from five botanical text-books, namely, those of Oudemans, Sachs, Van Tieghem, Oudemans and De Vries, and the third edition (1908) of the English translation of Strasburger, Noll, Schenck and Karsten. Had Asa Gray's "Structural Botany" been included, the results might have been more in accordance with the best modern taxonomic practice.

Prof. Moll's book is one which must be used to be appreciated. It would be idle to pretend that it is either attractive or readable. Perhaps it may best be compared with a vast and forbidding

quarry from which the skilled phytographer may hew the stones with which to build the stately edifices of his descriptions. Plant description is truly an art that cannot be taught, and no text-book will enable a botanist to make a really good pen-portrait of a plant if he possesses no aptitude for the task. All those whose work lies in the description of plants may nevertheless profit in varying degrees from a study of Moll's "Phytography", which will long remain as a memorial to his industry and undaunted spirit.

T. A. SPRAGUE.

# Time-Space

**Geometry of Time and Space**
By Dr. Alfred A. Robb. Pp. vii+408. (Cambridge: At the University Press, 1936.) 21*s*. net.

THE null results of experiments designed to detect motions relative to the *aether* gave rise to many outstanding achievements. But none of them possesses the qualities of survival to a greater degree than the work of Dr. Alfred A. Robb, which has now been republished, with certain modifications, improvements and additions. Dr. Robb, inspired by the influence of Sir Joseph Larmor, was early in the field, even before the publication of Einstein's "Restricted Theory of Relativity". The latter's work was very unsatisfactory from a philosophical point of view, so Dr. Robb persevered until, in 1911, he was able to publish his "Optical Geometry of Motion" which contained some of the germs of his major work, finally published under the unfortunate circumstances of 1914.

Many relativitists have felt uneasy about such concepts as "world-wide instant," the "relative character of simultaneity", etc. These concepts owe their existence to the method of approach employed by Einstein and his followers, notably Minkowski. They were led to regard kinematics as a kind of four-dimensional generalisation of ordinary Euclidean geometry, in which the time co-ordinate, multiplied by $\sqrt{-1}$, appears on the same footing as the space co-ordinates. Dr. Robb ultimately arrives at the same goal, but his starting point and method are fundamentally different. In particular, he has no use for those dubious instruments—the calibrated clock and transportable rigid measuring rod—by whose aid the geometry of space-time is usually set up.

The occurrence of *time* before *space* in the title is significant. The author adopts the view that the fundamental reality for an individual is the linear series of events which form his own temporal experience, and bear to one another the relations *after* or *before*. But a sense of vision, together with the properties attributed to light, supply him with a criterion for judging whether certain other events, outside himself, are *before* or *after* an event of his own experience. This latter set of events forms a series in conical order. Relativitists will recognise this series as constituting the light-cone. This idea of conical order is the foundation and core of Dr. Robb's work, and though frequent use is made of the light-cone model for illustration purposes—a model which may be very misleading in certain circumstances—the proofs in no way depend upon its use.

The method throughout is the method of pure geometry. The assumptions are clearly formulated in a series of twenty-one postulates, and the theory developed in a sequence of some two hundred theorems, definitions being given whenever a new term or concept is introduced. Co-ordinates are introduced at the end of the work so that, if desired, further developments can be achieved by the methods of co-ordinate geometry.

It is easily seen that the relation *after* (or its converse, *before*) is simpler than the relation *between* usually postulated in treatises on the logical foundations of geometry. The latter relation requires three elements for its fulfilment and the former only two. Another distinguishing feature of this geometry is the natural manner in which the idea of congruence emerges without having to be imposed from without by special postulate. As the author remarks in the introduction: "if *before* and *after* are used as basis, *congruence* appears as an intrinsic part of the subject". Of course, segments of arbitrarily chosen lines are not comparable in respect of congruence unless they are lines of the same type. In the language of relativity, *time-like* intervals are not to be compared with *space-like* intervals. There are, in all, three types of lines: the optical, inertia and separation lines. The first is the path of a light ray, the second the path of an unaccelerated material particle, while the third is the space-like line of relativity.

To each type of line there corresponds a plane and a three-fold, each with its own peculiar geometry. In particular, the geometry of a *separation* plane (or three-fold) is formally equivalent to Euclidean geometry. Parallelism and

normalism are defined in a simple manner for all types of line, plane and three-fold. The optical parallelogram (having optical lines as sides and an inertia and separation lines as diagonals) plays a conspicuous role in the development of the theory and serves to pave the way for the introduction of congruence, without the need of using measuring instruments.

Special interest attaches to Postulates XIX and XX. The former requires four dimensions for its fulfilment, while the latter limits the dimensions to just this number. But no one would be able to read these implications into them without a knowledge of the preceding work. In order to appreciate their significance they should be compared with the corresponding *axioms* in treatises on the logical foundations of geometry as, for example, in Hilbert's "Grundlagen der Geometrie".

Postulate XVII is the analogue of the axiom of Archimedes, but without the idea of congruence, though, later, the axiom in its entirety is shown to hold in this geometry. Peano's axioms for line and plane are also shown to be true.

A detailed discussion of the postulates would be out of place in a general review. It must suffice to state that they correspond closely to certain simple, readily accepted, optical facts. The author points out that some of them are redundant but that it is convenient to retain them for special purposes. A formal proof of the compatibility and independence of the remainder is not given. That they are compatible is fairly certain, but it would be interesting to get an answer to the question of their independence or otherwise. Postulate IV indicates the limitation of the geometry, so far as its application to the physical world is concerned. It implies that the series of events forming the temporal experience of an individual constitutes a continuum. But it is questionable whether personal experience can be chopped up indefinitely in this manner. Shades of the quantum creep in at this point, and the question must be left open.

The author has shown elsewhere that the theory is readily extended into $n$ dimensions when Postulate XX is discarded. In this connexion it is interesting to note that, of the $n$ mutually normal lines meeting in a point, one is an inertia line, while the remaining $(n - 1)$ are separation lines. This fact allows the setting up of a co-ordinate system of the Minkowski type.

The importance of Dr. Robb's work cannot be over-estimated, and every effort should be made to bring it to the notice of all serious students of relativity, as well as those interested in the logical foundations of pure geometry. T. LEWIS.

# Roman Mines and Mining Methods

**Roman Mines in Europe**
By Oliver Davies. Pp. xii+292+12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 30*s*. net.

IN this book, the author has brought together from numerous and widely scattered sources a large amount of interesting information relating to mining activity in Europe during Roman times. In it he includes observations made during his own extensive travels, carried out for the purpose of making first-hand investigation of the gold, silver, iron, copper, lead, mercury and tin ore deposits in which the Romans were interested and on which they carried out their mining enterprises.

In a general conspectus of sixty-two pages, which forms the first part of the book, the author deals with general considerations of Roman mining under the headings legal position, economic aspects, organisation, labourers, mining technique and metallurgical technique.

As regards legal position, not much information is available; but it is clear that in Roman times the State took a great deal of interest in minerals, and in many cases ownership of the minerals was vested in it. Under the later Empire, the State allowed private parties to work mines subject to the payment of ten per cent of the output to the Imperial Treasury and ten per cent to the surface owner, but, as regards the actual amount of the royalty charged, no doubt the amount varied with times and circumstances. The imposition of royalties on mineral output by the State and surface owners is thus a very ancient practice. In many cases, however, the Roman and other ancient States not only claimed ownership of minerals, but also actually worked the mines, using slave labour.

Economic conditions were much simpler, of course, than in modern times, machinery being of the very simplest and markets very much more restricted. Plenty of ore was available at and near the surface, and human energy was cheap. Mining methods, moreover, were wasteful; and much ore that we should consider good was thrown away as useless, only the best being recovered.

As regards mining science and technique, the Romans had only a scanty knowledge of geology and minerals, and veins lost by faulting were lost for good so far as their mining methods are concerned. They knew something about prospecting, however, and recognised many indications of ore, such as the coloured oxidation products of copper ore. They recovered gold by 'hushing', that is, by impounding or canalising waters which they directed in strong currents on to the soil or alluvium to wash away the lighter minerals and thus concentrate the gold. Their other mining methods included shaft-sinking, the driving of galleries and adits, and primitive efforts at lighting, ventilation and drainage. They used water-wheels, also iron, wood and stone tools including rilled hammers, specimens of which are often found in Roman mine-workings.

The metallurgical procedure of the Romans included crushing, washing on tables for the purpose of concentration, roasting and smelting in different kinds of furnaces. Thus their mining science was very defective, but their technique, though primitive, showed much skill and variety, and up to the standard of their requirements, was quite effective.

The remaining and larger part of the book is given to an account of mineral areas of Europe in which the Romans were interested and their mining work in these areas, including Italy, Gaul, Spain, the British Isles, Rhineland, Upper Danube provinces, Illyrian provinces, Dacia, Moesia, Macedonia, Thrace and Greece. The book has a topographical as well as a subject index, and is provided with useful maps and diagrams.

However pleasant the task of compiling this mass of interesting information may have been to Mr. Davies, it must have involved a large amount of painstaking work. Students of archæology and the history of mining will be grateful to him for the trouble he has taken to make the information available in such a handy form.

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**Forensic Chemistry and Scientific Criminal Investigation**

By A. Lucas. Third edition. Pp. 376. (London: Edward Arnold and Co., 1935.) 18s. net.

"FORENSIC CHEMISTRY" is not a very intriguing title but, interpreted in the generous spirit of the author of this work, it covers a varied range of phenomena, and it is certainly interlinked with some of the most tragic dramas of the century. The book may be considered under two aspects. It is primarily a textbook for the expert witness, or for him who would aspire to reach that third and highest plane. For him Mr. Lucas gives clear and meticulously careful advice on the manner of preparation of a report, and macroscopical, microscopical and general and special analytical methods are described which cover almost every happening in the annals of crime. The help that physical science may give is not forgotten, and X-rays, ultra-violet and infra-red photography, and methods for the determination of specific gravities and refractive indices are all pressed into service.

The work has, however, dramatic elements in it which should attract the general scientific reader as well as the specialist witness. In the service of detection nothing is too great, nothing too trivial, and we pick up by the way much lore concerning the age of inks, the date of the introduction of black-lead pencils, the deciphering of documents, the composition of their seals, the making of plaster casts of footprints—in fact, we learn that Dr. Thorndyke is a very real person, and Sherlock Holmes's immortal treatise on the varieties of tobacco ash almost finds its fellow in Mr. Lucas's chapter on tobacco.

"Sand taken from the stomach and duodenum of a drowned man was examined and, as the quantity available was very small, only a microscopical examination was possible. The material was found to consist essentially of colourless grains, all very angular, and many having definite crystalline form that proved to be selenite; there was an absence of quartz, but on one slide there was part of a diatom. The presence of selenite in large proportion and the absence of quartz seemed to preclude the Nile valley and suggested the northern shores of Egypt. It was probable, therefore, that the man was drowned off the coast where his body was found and that he had not been transported there after having been killed elsewhere, as was at first thought might possibly have been the case."

Surely this is in Dr. Thorndyke's best manner?

Specialist and general reader alike will echo Mr. Lucas's wish that the scientific part of the evidence in the otherwise admirable reports of some well-known criminal trials should be given in full. The obscurities which result from condensation are peculiarly irritating. A. F.

**The Social Economy of the Himalayans:**

based on a Survey in the Kumaon Himalayas. By Dr. S. D. Pant. Pp. 264+23 plates. (London: George Allen and Unwin, Ltd., 1935.) 15s. net.

DR. PANT'S book, an account of a too-little known people of the Kumaon Himalayas, is a serious contribution to the social anthropology of Indian peoples by one of themselves, based upon nearly five years of first-hand observation and investigation. The author gives a detailed account of the social and economic institutions of the Bhotiyas and other peoples of the district under survey, their methods of agriculture, their industries, trading activities, recreations and religious festivals. The governing factor in their economy is a climatic environment which makes of them seasonal nomads, migrating from lowland to upland and back as winter changes to summer and then returns—a mode of existence of special interest to both anthropologist and geographer.

### The Water Line of the City of London after the Great Fire

By Sydney Perks. Pp. v+38+13 plates. (London: Taylor and Francis, 1935.) 12*s*. 6*d*. net.

An interesting feature in connexion with the rebuilding of London after the Great Fire of 1666 is that, at the outset, "it was decided that the buildings which had existed up to the edge of the River Thames should not be re-erected on the old sites; that no new structure should be built within 40 feet of the river; and also that wharves or quays should be constructed from London Bridge to the Temple". Mr. Sydney Perks, late Architect and Surveyor to the Corporation of the City of London, with his exceptionally privileged opportunities of consulting old records not generally accessible to the public, has been at considerable pains to investigate how far these proposals were adhered to, and the volume under notice gives a documented account of the result of his researches. There is a certain amount of contradictory evidence which is carefully sifted and the grounds for acceptance or non-acceptance stated. Much of the information has had to be collected from widely different sources—minutes of committees, survey books, site plans, cash books dealing with coal dues, etc.—and pieced together so as to form a connected picture of the course of local events, which, as Mr. Perks laments, failed to engage the attention and recording ability of Pepys, busy as he was with national affairs.

Mr. Perks's exhaustive survey leads him to condemn the water-line with an area of open land corresponding to the regulation width, shown on the plan of Ogilvy and Morgan, published in 1677: it existed, he says, only in the minds of those mapmakers. He finds that the original idea for a "Key or Wharf" along the river front was to facilitate dealing with buildings on fire, and that, at first, the owners of land refrained from building within 40 feet of the water line, but that, so early as 1669, the new Fishmongers' Hall constituted an important encroachment, which, though challenged, was allowed to remain, and that thereafter other builders followed the example which had been set, so that the original intention was gradually abandoned. B. C.

### Gmelins Handbuch der anorganischen Chemie

Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 4: Stickstoff. Lief. 1. Pp. 282. (Berlin: Verlag Chemie G.m.b.H., 1934.) 43 gold marks.

The first volume on nitrogen deals with its occurrence in Nature, its fixation in the soil by natural processes, its isolation from air and from compounds, its general properties and with numerous researches upon active nitrogen. A condensed summary of forty-five independent determinations of the atomic weight of the element will be found.

There is also a detailed account of investigations upon the nucleus, which have been classified as transformations, since all observed cases of nuclear disintegration have also been nuclear syntheses. The bombardment of certain atoms with fast-moving particles has revealed the existence of isotopes of nitrogen, which have escaped detection by the mass-spectrograph. Thus whereas the atom of boron $B^{11}$ when bombarded by an $\alpha$-particle yields a neutron and ordinary nitrogen $N^{14}$, the isotope $B^{10}$ produces the interesting radioactive nitrogen $N^{13}$, which disintegrates into a positron and the carbon isotope $C^{13}$. Radionitrogen has also been produced from $C^{12}$ and deuterium $H^2$. Nuclear transformations have also yielded two heavier isotopes, $N^{15}$ and $N^{16}$, and heavier products, fluorine and oxygen.

Distinction is drawn between electrically active and chemically active nitrogen, since the two properties are independent of one another although they may co-exist. The term 'active nitrogen' is generally used to describe the electrically excited variety first produced by Strutt in 1911, which is characterised by its after-glow. It is also chemically active, but chemical activity can be produced in other ways. Electrically active nitrogen is believed to be a mixture of metastable molecules with ordinary and metastable atoms. The possible existence of triatomic molecules is also discussed. It has been shown that the removal of all ions is without effect upon both chemical activity and after-glow.

### Industrial and Manufacturing Chemistry

Part 2: Inorganic. A Practical Treatise. By Dr. Geoffrey Martin. Vol. 1. Fifth edition, revised by Geoffrey Martin. Pp. xx+496. (London: The Technical Press, Ltd., 1935.) 28*s*. net.

Dr. Martin's compendia are well known; their wide utility is proved by the succession of editions. The present volume has been kept well up to date, partly with the aid of practical suggestions furnished to the author; he has had the assistance of ten contributors, all of whom are well known as practical chemists.

The scope of the work includes fuels, industrial gases, water technology, inorganic acids and alkalis, gypsum and barium salts, the chlorine industries and the nitrogen industries. No better introduction to any of these is required than is here furnished, and the volumes may well form the foundation of any chemical engineer's library.

### The Foundations of Human Nature:

the Study of the Person. By Prof. J. M. Dorsey. (Longmans' Education Series.) Pp. xiv+488. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1935.) 12*s*. 6*d*. net.

This volume in Messrs. Longman's Education Series is written by Dr. Dorsey, who is associate professor of psychiatry at Michigan for educators and social workers who are striving, very often unsuccessfully, to learn all about personality. There is a great deal of common sense in the book, and those who work steadily through it cannot fail to benefit. The author wisely points out that most juvenile delinquents can recite the Ten Commandments, but that those who taught them to recite did not at the same time obtain *rapport* with their personalities and teach them how to apply what they so glibly recite.

# Spectrographic Equipment of the 200-inch Telescope

PREVIOUS to the designing of the $f/0 \cdot 36$ spectrographic object-glass referred to in Dr. G. E. Hale's article (see special supplement to NATURE of February 8) observations made at Mount Wilson Observatory by means of the $f/0 \cdot 59$ Rayton lens had shown that the apparent velocities of recession of the more remote nebulæ are extraordinarily high and that they increase with the distances of the nebulæ. These observations had been extended as far into space as appeared to be practicable with the $f/0 \cdot 59$ Rayton lens, and it was with the object of increasing the range within which the nebulæ could be investigated spectrographically that the designing of a spectrographic lens of larger aperture was undertaken by the British Scientific Instrument Research Association.

The equivalent numerical aperture (0·85) of the Rayton lens was already very nearly as large as could be obtained in any well-corrected 'dry' lens, and it was obvious that an 'immersion' lens would be needed if any large increase of aperture were to be achieved. With an object-glass designed to be used with a fluid of chosen refractive index between the last lens and the photographic film or plate, the limit of numerical aperture theoretically obtainable is equal to the refractive index (1·55) of the gelatine of the photographic emulsion. This limit cannot be reached in practice, but it appeared probable that a numerical aperture of 1·4 might be obtainable, which would represent approximately a three-fold increase in 'rapidity', very nearly doubling the range within which the apparent velocities of the nebulæ could be investigated. On general grounds it was considered worth while to aim at a design which would give a flat field over the range of spectrum which is of main interest in studying nebular velocities, in order that difficulties associated with the use of curved films might be avoided. A preliminary exploration of possible designs indicated that a system to fulfil these requirements should be capable of being produced without great difficulty, and, out of the designs considered, one was selected for detailed computation.

It was foreseen that difficulties might arise in the subsequent use of the lens if the immersion fluid to be used with it should prove to have any deleterious effect on the usual photographic emulsions. Experimental tests on plates which had been immersed for several days in the selected immersion fluid showed that this liquid had no perceptible action on the plates, and that the liquid could be removed quickly and completely in readiness for the plates to be developed. As a precautionary measure the lens was designed so that, if necessary, the thickness of the back lens could be reduced sufficiently for the lens to be used with specially thin plates with their glass sides in immersion contact with the back lens; it was, however, made up to be used in direct immersion contact with the coated sides of ordinary photographic plates. In the work which has been done with the lens, there has been no evidence of action between the immersion fluid and the emulsion.

A lens designed for spectrographic work may be considered as distinct from all the usual types of object-glasses. It is required to form separate line-images from a series of beams of parallel light of different colours all travelling along directions inclined at different angles to the axis of the lens. The corrections required for a lens to be used in this way are unlike those necessary in photographic lenses, telescope object-glasses, etc., and can be obtained by somewhat different methods. Achromatism, for example, as the term is ordinarily used, is not essential, and a certain amount of astigmatism can be tolerated in the images formed on either side of the axis. A lens entirely free from secondary spectrum and with an anastigmatically flattened field would, it is true, be ideal for use as an astrospectrographic object-glass, but in view of the impossibility of producing such a lens with an adequate aperture for the problem in hand, alternative methods of obtaining the necessary types of corrections were investigated.

An ordinary achromatic object-glass, corrected so as to give an anastigmatically flattened field, would be of little value as a spectrographic object-glass except with *curved* films. Its secondary chromatic errors would cause light of different colours to be brought to focus in different planes, so that the surface passing through the images formed by light of different colours would be curved. An achromatic object-glass having a curved field when used as an ordinary lens could, however, give an accurately focused spectrum on a flat plate, provided that the curvature of field were exactly compensated by the variation of focal distance due to the residual (secondary) chromatic errors of the lens. In designing a lens of numerical aperture 1·4, it is necessary to follow the general lines adopted in the designing of

microscope object-glasses of large aperture. The residual chromatic errors of such lenses are small, and the field-curvature is so large that it would more than compensate for the curvature which these residual chromatic errors would introduce in the focal surface of a well-dispersed spectrum. It is permissible, however, to ignore any slight astigmatism of a spectrographic object-glass, provided that the *tangential* astigmatic images of the spectrum lines are brought to focus on the photographic film or plate. Thus, it is permissible to compensate for the curvature of field left unbalanced by the 'secondary spectrum correction', by introducing corrections which would flatten the focal surface passing through the tangential astigmatic images.

The method used to flatten the tangential astigmatic field was one which, in addition, introduced under-correction for spherical aberration in oblique image-forming rays. For the complete system under consideration, comprising the collimator, prisms, and the $f/0\cdot36$ lens, the obliquity of the ray-systems on one side of the axis increases as the wave-length of the light becomes shorter, and the under-correction at increased obliquity can be made to balance the over-correction due to shortening of the wave-length. Hence, proceeding outwards from the centre of the field, correction for spherical aberration can be maintained over a considerable distance. On the other side of the axis the obliquity of the ray-systems increases with increase of wave-length, and spherical aberration is increased more rapidly than it would be if the field were not flattened. Since, however, the important range of spectrum to be investigated is confined to the shorter visible and near ultraviolet radiations, imperfect imaging of the yellow and red regions of the spectrum is of no importance, and satisfactory imaging over the required range can be ensured by designing the lens so that some selected blue or violet radiation would pass axially through it.

The design of the lens followed the lines indicated by the considerations briefly outlined above. It was necessary, of course, to have particulars of the angular dispersion which would be given by the prism system to be used with the lens, and also to be informed of any residual errors of the collimator lens. The design as finally developed was for a lens of the required aperture, with full spherical correction and giving a flat field for dispersed parallel beams covering the range of wave-lengths between 3600 A. and 5000 A. In the design, also, special attention was paid to ensuring that the sine condition should be fulfilled and to eliminating any independent coma of a higher order, so that the entire spectrum should be free from coma.

The mounting of the back component of the lens system required special consideration to ensure that optical contact should be maintained between the back lens and the photographic plate during the longest exposures likely to be given. In view, also, of the very short 'depth of focus' of the lens, specially fine differential-screw focusing adjustments were provided and the plate-carrier was designed as an integral portion of the lens mounting. A sensitive tilting adjustment was also fitted to the plate carrier in order that the plane of the photographic plates could be brought into coincidence with the focal surface. Both these adjustments were provided with clamping systems so that, when once the lens and plate-carrier had been set in their proper relative positions, plates could be changed with the certainty that each plate would automatically be brought into the proper focal plane.

When the collimator, prism system, and large aperture lens had been constructed, the complete system was examined optically in the laboratories of the British Scientific Instrument Research Association, and was found to realise fully the expectations founded on the calculations made during the designing of the lens. By adopting a similar method of examination, it will be possible at any time to mount the complete outfit in a telescope, ready adjusted, so that loss of time in testing the adjustments by trial exposures on astronomical objects may be entirely avoided.

The complete spectrographic equipment was delivered to the California Institute of Technology in December 1934 and was tested on the 100-inch telescope at Mount Wilson after the necessary mountings had been completed. In the tests first carried out on the remote nebulæ, the results obtained were disappointing. Work on other astronomical objects showed, however, that the optical performance of the system is of the high order indicated by the calculations and by the tests made before dispatch, and that the disappointing results obtained on the nebulæ were due to fogging of the spectra by light from the night-sky at Mount Wilson. To a large extent this is scattered light from the towns in the San Gabriel valley; at Mount Palomar, where the new 200-inch telescope is to be erected, the night-sky is appreciably darker, and it is confidently hoped that, when the lens comes to be used there, it will fulfil the purpose for which it was originally designed; although a limit to the range within which the nebulæ can be explored may possibly be set by the natural brightness of the sky due to auroral light.

In the meantime, the lens is proving of very great value in investigating differences between

the radial velocities of the individual stars in star-clusters in the extra-galactic nebulæ, and a wide variety of other uses is foreshadowed for which the lens is peculiarly fitted owing to its extreme rapidity.

Dr. Hale, in a letter describing some of the results already obtained, refers to the lens as "a great success optically", and expresses his congratulations on "a truly remarkable achievement". It reflects great credit on the optical industry of Great Britain to have produced a lens having such outstanding possibilities.

# Matthew Boulton as Scientific Industrialist

THE commemoration in January last of the bicentenary of the birth of James Watt naturally directed attention to the notable part taken in the development and application of the steam engine by his partner Matthew Boulton, and in his "James Watt, Craftsman and Engineer", Mr. H. W. Dickinson expresses regret that hitherto no separate biography of Boulton has been written (see NATURE of January 25, p. 129).

The career of Boulton, of course, has not escaped the writers on Watt and the steam engine, and Smiles in particular dealt at considerable length with many of his activities. But the life of Boulton, relating to which we imagine there is much unexplored material, deserves still closer study, for in the history of the industrial progress of Great Britain during the latter half of the eighteenth century, there is no more engaging figure. He was a man of admirable character, broad-minded, generous, energetic and far-sighted, displaying many of the attributes of a statesman. Unlike many of his contemporaries in the field of industry, he started life with social advantages, and early in life was a man of means. But if, as he himself declared, he loved money-getting projects, he was still more concerned that nothing but the highest standard should be aimed at, whether it was in connexion with his own affairs or those of the nation. As a captain of industry he had no equal, and was alike at home whether dealing with his employees, his partners, privy councillors or prime ministers.

Boulton was the senior of Watt by more than seven years, having been born in Birmingham in September 1728. The two first met when he was nearly forty years of age, and was the head of the largest manufacturing concern in the country. His father had begun as a silver stamper and piercer, and when he died in 1759 he left his son a well-established business for the manufacture of trinkets, steel buttons, buckles and the like. In 1762, Boulton married Ann Robinson of Lichfield and with her came a fortune of £28,000. This accession of wealth, instead of diminishing his interest in trade, enabled him to launch out on new ventures and he proceeded at once to erect the famous Soho Manufactory about two miles north of Birmingham, having for his partner John Fothergill. When completed, the Manufactory could house six hundred workpeople, and by 1767 the firm had a turnover of £30,000. No mean inventor himself, versed in the science of his day and possessing artistic tastes, Boulton introduced new machinery and processes, and was at as great pains as Wedgwood to apply art to industrial products. He had agents in many foreign capitals, his showroom in London was visited by dukes and lords, and at his house at Soho he dispensed a princely hospitality.

Like other manufacturers, one of the problems Boulton had to face was that of power supply, and one of the reasons for placing the factory at Soho was that water-power could be obtained from the Hockley Brook. The supply, however, was unreliable, and even before Watt first visited Birmingham, Boulton had already considered the proposal to instal a 'fire engine' for pumping the tail race water from the water wheels back to a reservoir. When Watt went to Soho in August 1768, Boulton was, therefore, ready to seize on any project which would effectively overcome his difficulties, and it is a remarkable tribute to his judgment of men and to his insight into the future of the steam engine that, although no patent had yet been secured and no full-sized engine erected embodying Watt's principle of the separate condenser, Boulton was ready at once to stake his all on the success of the new engine.

The patent was secured in January 1769 and a month later Boulton wrote to Watt that his "idea was to settle a manufactory near to my own by the side of our canal where I would erect all the conveniences necessary for the completion of engines, and from which manufactory we would serve all the world with engines of all sizes". Though in his short intercourse with Boulton he had conceived a great liking for him, to the nervous, desponding and impecunious Watt such a scheme might well have appeared rash, almost to madness, and as a matter of fact five valuable

years were allowed to slip by before Boulton saw his way clear to carry his plans into effect.

Without attempting to trace again the interesting story of the development of the engines with which the names of Boulton and Watt are inseparably connected, it may be said that if Boulton claims our admiration as a judge of men, an industrialist and an organiser, he also deserves recognition as one of the few manufacturers of his time who were devoted to scientific pursuits. Had he lived to-day, he would undoubtedly have been one of the keenest advocates of scientific research for industrial purposes. As a boy he studied mechanics and chemistry, in middle age he was one of the most prominent figures in the celebrated Lunar Society, which included among its members Watt, Priestley, Wedgwood, Withering, Erasmus Darwin, Keir and Galton; and when immersed in the difficulties of negotiations with Cornish miners could write: "chemistry has for some time been my hobby-horse . . . I am almost an adept in metallurgical moist chemistry. I have got all *that* part of Bergmann's last volume translated, and have learnt from it many new facts". Years before, in 1757, when in correspondence with Benjamin Huntsman, the pioneer of the steel industry of Sheffield, he wrote: "I hope thy Philosophic Spirit still laboureth within thee, and may it soon bring forth Fruit useful to mankind, and more particularly to thyself".

The philosophic spirit possessed Boulton all his life, and when seventy years of age and holiday-making at Cheltenham, he must needs have his chemical apparatus so that he could make careful analysis of the waters of the place, the results of which were all duly entered in minute detail in his memorandum books.

The chief activity of the later years of Boulton were connected with the improvement in coining and the coinage of the country. He improved the processes of minting out of all recognition, and at Soho laid down a plant which for many years served as a model for this and other countries. In his enterprise he showed the same thoroughness, the same power of organisation, the same appreciation of the application of science and art to a great practical need that marked his work on the steam engine.

# Obituary

## Sir Joseph Petavel, K.B.E., F.R.S.

BRITISH applied science suffered a grievous loss in the death of the director of the National Physical Laboratory, Sir Joseph Petavel, on March 31. Sir Joseph, who was sixty-two years of age, was second director of the Laboratory, succeeding Sir Richard Glazebrook in 1919 and surviving him by only a few months.

Sir Joseph, who was born in London on August 14, 1873, was a son of the late Rev. E. Petavel. He received his early scientific training at University College, London, under Sir Ambrose Fleming, with whom he collaborated in his first published paper, on the alternating current arc. With the aid of an 1851 Exhibition Scholarship, he then worked under Dewar for three years at the Royal Institution and Davy Faraday Laboratory, where he studied the thermal emissivity of platinum at high temperatures and pressures. In later years he had many reminiscences to tell of his experiences at the Royal Institution.

Then came Petavel's election in 1900 to the John Harling research fellowship at Owens College, Manchester, following which he became lecturer in mechanics under Schuster. He published notable contributions on very high pressures as generated, for example, by solid and gaseous explosives. In 1904 he was responsible at the St. Louis Exhibition for the management of the liquid-air plant which was shown by the British Royal Commission. Four years later, Osborne Reynolds resigned the chair of engineering, and Petavel was elected in his place as professor of engineering and director of the Whitworth Laboratories at the University of Manchester. Further outstanding papers had meanwhile been published jointly with R. S. Hutton, on electric furnace reactions under high pressures and the effect of pressure on arc spectra.

About this time Petavel was developing an interest in meteorology and aeronautics, and collaborated in an investigation on kite soundings as applied to upper-air temperatures. In 1909 he became a member of the original Advisory Committee for Aeronautics, and presently took up the study of the stability of aeroplanes. His enthusiasm led him to qualify as a pilot, an accomplishment by no means free from danger with the experimental aeroplanes of those days. It was during this period that he was the victim of a serious accident which might well have proved fatal, and indeed left its mark on him all his life. When the Aeronautical Research Committee was formed in 1917, Petavel was appointed chairman of the Aerodynamics Sub-Committee and a member of several of the other sub-committees. He also served as vice-chairman of the main Committee for many years until his death. In these various capacities he exercised a profound influence on the progress of aeronautical research in Great Britain.

From 1911 until 1916 Petavel had been a member of the General Board of the National Physical Laboratory, and when the directorship of the

Laboratory became vacant in 1919, he was called to fill Glazebrook's place. The new responsibility was one which might well have daunted many men; but Petavel brought to bear all his experience and great natural powers, and has left behind him a record of devoted and successful direction which will be long remembered. He fully maintained the high traditions set by his predecessor, and under his guidance the Laboratory steadily enhanced its influence and prestige. The staff grew to nearly seven hundred strong, and the former grounds of Bushy House were expanded from twenty-three to some fifty acres, so that adequate provision was made for future extensions of the work of the Laboratory to meet the ever-increasing demands of industry.

Petavel was a man of tenacious views and had a highly-developed critical faculty which stood him in good stead, and which he was accustomed to apply to everything that came before him whether significant or trivial. Few men can have had so fine an eye for detail, whether as the courteous and charming host or as the head of a great Laboratory for which he slaved unremittingly, working long hours into the night. At all times, the Laboratory came first and foremost in his thoughts, and nothing was too unimportant to escape his attention among the vast ramifications of interests with which he had to deal. He always emphasised the paramount importance of ensuring the high national and international authority of a National Physical Laboratory test or investigation: the accuracy must be unquestionable. His memory was encyclopaedic, accurate and long-lived, and he kept himself singularly well informed of the progress of the almost countless developments in the various departments of the Laboratory. He possessed the faculty of trenchant comment, and would infallibly diagnose the strength and the weaknesses of a scientific report or paper. He had a liking for the parable and the metaphor in speech, often combined with a turn of whimsical humour. His staff came to realise his faculty for wise counsel, and even when it was unpalatable the recipient found it tempered by the kindly smile which accompanied it.

Petavel could always be relied upon to make major and constructive contributions to the manifold problems connected with the design and layout of new and unique equipment or buildings, the erection of which went on almost unceasingly during his directorship. Among these were individual laboratories for research in high voltages, physics, acoustics and photometry, a compressed air tunnel for aerodynamical research, further wind tunnels of the open-jet type and an additional tank for testing ship models.

Petavel was made a K.B.E. in 1920, a fellow of the Royal Society in 1907, and a member of the Athenæum under Rule II in 1920. He presided over Section G (Engineering) of the British Association in 1919. His duties on Government and other committees were exceptionally heavy. Among them were numerous boards and committees of the Department of Scientific and Industrial Research, the British Electrical and Allied Industries Research Association, and the British Standards Institution. He was, or had been, a member of the National Radium Commission, the Board of Visitors of the Royal Observatory, Greenwich, and of the Engineering Board of Studies of the University of London.

Sir Joseph commonly gratified his taste for wide travel during vacations, but at home two great delights occupied his private life—Bushy House and its garden. Bushy House, the former royal residence of Queen Adelaide, which since the foundation of the Laboratory has served as the director's residence, he lovingly adorned with period furniture and transformed into a house of beauty and refinement. He gave like attention to the 200-year-old garden, which he largely remodelled, and to the grounds of the Laboratory, which he constantly sought to beautify. Each spring tens of thousands of daffodils have given delight to his visitors and staff and they will long serve as beautiful if poignant reminders of him who gave them being.

Nothing pleased Sir Joseph more than to share his house and garden with his guests, and there are very many who will treasure happy recollections of his overflowing hospitality and the spirit which prompted him to cheer his parting guests with large bunches of flowers lavishly culled from his garden. He greatly interested himself in the welfare and social activities of the staff of the Laboratory, by whom the sense of profound personal loss occasioned by his early death is felt acutely and universally from top to bottom. Many of them cherish tokens of his kindness and friendship.

Sir Joseph, who was unmarried, showed great and characteristic fortitude to the last in his painful illness. He was interred at Highgate Cemetery on April 4. A memorial service was also held at Hampton Parish Church at which the president of the Royal Society, Sir William Bragg, paid a touching and eloquent tribute to Sir Joseph's life and work.

G. W. C. KAYE.

## Sir Frederick Norman

SIR FREDERICK NORMAN, who died on March 17 at Runcorn, was one of those pioneers of applied science whose life was devoted to his work and to local affairs. He was difficult to know intimately: always pleasant, well-informed and interesting, he was a man of high character and had very great local influence, particularly as a Cheshire magistrate and as chairman of the Runcorn Bench. He suffered a severe loss at the end of the Great War in the death of his only child, Stanley, a young chemist of very great promise. He was a man of great generosity to local institutions and lent a helpful hand to very many in all stations of life.

Norman, who was born on February 18, 1857, began at Wiggs Brothers' works at Runcorn, which later became part of the United Alkali Co., and he was always in command of the works on the Cheshire side of the River Mersey, which he advocated as the finest site in the world for the production of heavy chemicals. The main development of the United Alkali Co. was then on the Lancashire side, the salt, which is the basis of this industry, being in Cheshire.

It is worthy of note that the original works of Gossage and others were put on waste ground at Widnes, so that the escaping acid fumes did least harm under the prevailing wind conditions to the neighbours.

Time has already largely proved that Norman was right. His early work was concerned with the recovery of copper and precious metals from burnt ore, and he devised a process for the production of a red oxide of iron pigment from the spent liquors, which was worked successfully for many years by the Liverpool and Hull Red Oxide Company.

Norman's interest in metals continued throughout his life, and he was in close contact with leading men at home and abroad on developments in the metallurgy of iron, copper, zinc, etc. In copper recovery he early recognised the merits of the Ramén mechanical furnace, and continually studied other aspects of copper recovery until post-War developments at home and abroad reduced to small dimension in England what had been a large and profitable business.

It was at Wigg Works that the Raschen process for cyanide manufacture was successfully operated for some years from 1898 on until, like other processes of the period, it had to yield place to the Castner method of starting from metallic sodium. The Raschen process was based on the oxidation of sodium sulphocyanide by air, using nitric acid as an intermediary in the oxidising vessels and regenerating this in towers from the liberated nitric oxide. Such production of nitric acid from nitrogen oxides is now carried out on an immense scale in the present-day methods of nitric acid manufacture. Prior to 1900 it was difficult, more especially in construction and design of plant and choice of material. It may be recalled that an accident on the Wigg plant demonstrated the violently explosive character of the endothermic nitric oxide—a property then barely known, but one which had to be guarded against.

In 1928, Sir Frederick gave up his position as manager of the United Alkali Company, after fifty-seven years' service, to become consultant on non-ferrous metals for Imperial Chemical Industries, Ltd. He was knighted in 1914 and for his services during the Great War made a deputy lieutenant of Cheshire.

## Prof. F. B. Jevons

We regret to record the death of Prof. F. B. Jevons, formerly professor of philosophy and a vice-chancellor of the University of Durham, which took place on February 29 at the age of seventy-seven years.

Frank Byron Jevons, second son of John William Jevons of Doncaster, was born on September 9, 1858. He was a scholar of Wadham College, Oxford, taking first class honours in Classical Moderations and in Literæ Humaniores. In 1882 he was appointed to the staff of the University of Durham, where he spent the whole of his academic career, being classical tutor in 1882–1910 and professor of philosophy in 1910–30. He held a number of high offices in the University, and was vice-chancellor in 1910–11.

In his early work as a classical scholar, Jevons already showed, notably in "The Prehistoric Antiquities of the Aryan People", in his edition of Plutarch's "Roman Questions" and in his "Manual of Greek Antiquities", that his bent lay not so much in the direction of pure scholarship as in the study of the development of the religious and philosophical conceptions of the peoples of antiquity. A "History of Religion", which had already reached its seventh edition in 1896, traced the origin of religion to totemism, and established Jevons, in company with such men as Robertson Smith and Andrew Lang, as one of the protagonists in the discussions on the origin and development of religious ideas, which were a marked feature of anthropological thought at that time. His "Idea of God in Early Religion" appeared in 1910, and he was also the author, among other works, of "Religion in Evolution" and "A Study of Comparative Religion". Although recently, the diversion of anthropological studies to other methods of approach has somewhat obscured his contribution to humanistic studies, his work is of enduring value, his profound knowledge of the conceptions of antiquity compensating in some degree for his lack of first-hand knowledge of the ideas of primitive people—a lack which, indeed, he shared with the more prominent of the controversialists who were his contemporaries.

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Bohemian palæontology has suffered a great loss by the death of Prof. C. Klouček on October 11, 1935. He was born in 1855 and began life as a sculptor. In 1903, when more than fifty years of age, he started collecting fossils from nodules and stones on the land in the neighbourhoods of Rokycany and Prague. In these (Lower Ordovician $D\gamma$) he found many new species of trilobites and other forms of life. He likewise proved that the Osek-Kváň series of Ordovician age represented two distinct faunistic horizons. But his greatest discovery came from his study of the Tremadocian, which he began in 1913. Before his day, these beds were little known, so that he can be regarded as the discoverer of the Tremadocian in Czechoslovakia. He did very important work in the stratigraphy of these beds, dividing them into various horizons, according to the type fossils.

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We regret to announce the following deaths:

Prof. Robert Barany, of the University of Uppsala, who was awarded the Nobel Prize in medicine in 1914 for his work on the physiology and pathology of the ear, on April 8, aged fifty-nine years.

Major W. H. D. Clark, O.B.E., sometime chief examiner and later Assistant Comptroller of the Patent Office, on April 9, aged seventy-six years.

The Hon. Stephen Coleridge, director of the Anti-Vivisection Society and formerly president of the League for the Prohibition of Cruel Sports, on April 10, aged eighty-one years.

# News and Views

### The Race Problem

THE analysis of factors contributing to popular judgment in discriminating between races, which appears in another column of this issue of NATURE (see p. 635), agreeing substantially with the views expressed by Prof. Julian Huxley in his Friday Evening discourse before the Royal Institution on March 27 (see NATURE, April 4, p. 570), also lends support to his contention that a serious effort should be made to put an end to the propagandist exploitation of pseudo-scientific inference, depending upon the use of the term 'race', in political and nationalist activities. It is problematic, however, whether any pronouncement following on an international inquiry, which Prof. Huxley suggests as a possible remedy, would be effective, whatever the course adopted to secure that it should be widely known and generally accepted. Apart from practical difficulties, which are considerable, but of course not insuperable, clearly such a pronouncement, if it is to go beyond the fact, which is patent, that scientific terminology is being abused, must be based upon some agreement as to the meaning of the term, of which it attempts to regulate the use. It is open to question whether such agreement could be attained at present among representative students of man—students of man's structure, descent, heredity, varieties and distribution—even without entering upon the thorny problems of racial psychology and culture. If, however, the major objective of such an inquiry were the purely scientific aim of clarifying current ideas on race among anthropologists, even though it ended indecisively, or, as is not impossible, in a deadlock—*Germania contra mundum*,—it would clear the way, at present blocked, for rapid progress in racial studies. It might even be found desirable that a term of coinage now so debased should be eliminated entirely from scientific use. In the meantime, it is a function of science to expose ruthlessly on every occasion loose thinking and an inexact terminology; and perhaps, in this way, the pitfalls of 'race' can best be brought home to the man in the street.

### Fire-Walking

BULLETIN II of the University of London Council for Psychical Investigation consists of a report on two experimental fire-walks in which the preparation and performance were submitted to careful observation. Of the many accounts of fire-walking in different countries, this is the first to give a detailed description of the preparation of the fire, the internal and surface temperatures, and the times of contact of the skin with the embers. For the first time, therefore, an estimate of the magnitude of the performance can be made: it does not consist of wandering amongst flames with a look of exaltation, but of four rapid steps on charcoal at 430° C. with an average time of contact of half a second per step. Nevertheless, amateurs are not able to equal this, and the two who tried to imitate Kuda Bux developed blisters after only two steps. In attempting to account for the greater immunity from burning of Kuda Bux, chemical treatment need not be considered, since very careful tests were made to exclude this possibility.

Two hypotheses require examination, apart from obvious factors such as skill in the manner of walking, knowing the correct stage during the combustion of the fire at which the ash (which might adhere to the feet) must be raked, and, after a suitable interval, the attempt made. First, the increased immunity may be due to practice, for it is well-known that constant handling of hot materials produces an insensibility to heat which is accompanied by an absence of reddening and blistering although the skin may not appear in any way abnormal. Secondly, it is possible that a certain induced mental state is required, for it has been observed that under hypnosis, for example, very unusual bodily reactions may occur. This would account for the elaborate ritualistic preparation adopted in many countries and for Kuda Bux's assertion that 'faith' was necessary. Kuda Bux's own preparation appeared to consist merely in reciting a few lines from the Koran. One thing is certain: if the fire-walk is performed regularly the first hypothesis cannot be excluded. Whether or not the second hypothesis must be made in addition is a question that requires further research. The bulletin contains an extensive bibliography and nineteen plates which illustrate clearly the conditions under which the experiments took place.

### Prices for Electric Supply

THE paper read by Prof. Miles Walker to the Institution of Electrical Engineers on April 2, discussing the prices for electric supply in Great Britain, will interest all who try to see the reasons for the great disparities in the prices charged. It would naturally be thought that low prices would only be found where distribution costs per unit are low. But this is not the case, for they are found also in residential areas where higher prices might reasonably be expected. As an example, Prof. Walker quoted the Oxford supply, where a company had been in existence for about forty years; when, in 1931, the supply was taken over by the municipal authorities, drastic reductions were made in the cost of supply. The result has been that the total net income earned is now a greater percentage of the total capital involved than when the prices were high in 1931. In other words, if the company had had the courage to reduce the prices from almost the highest in the country to almost the lowest for that kind of district, it would have been able—provided it managed as well as the corporation—to pay a slightly larger dividend. In Prof. Walker's opinion, the main

difficulty is to evolve some method of charging which will apportion to each consumer his proper share of the standing charges. He made a most ingenious suggestion for constructing meters the rates of which would depend on the times of the day at which the consumer would be taking his loads. We foresee that there would be great difficulties in explaining this system of charging to new consumers and serious difficulties with electric motor-clocks, and humming noises would have to be overcome.

ANOTHER suggestion made by Prof. Walker for improving the load factor of our central stations and thus enabling prices to be reduced is to utilise the potential power load of motor-cars and omnibuses for equalising the load. Much has been said about the advantages of making petrol and oil from British coal; but if the problem is to transfer the energy stored in our coal to the axles of our motor-cars, it is very much more efficient to generate electrical energy by means of big turbo sets, store it in batteries, and empty it in electric motors, than it is to convert only a fraction of the coal into petrol and employ that in internal combustion engines. If the distribution of electricity were on a national scale, we should have to dot about the country hundreds of battery stations at distances not greater than ten miles apart. Electric cars could be built taking batteries of a standard size. The driver of the car would only have to stop at a station every 20 miles or so and change his battery. It could be mounted and wheeled about in such a way that the process of changing it would be as easy as filling up with petrol. If it were necessary to have a tax, it could be imposed upon the charged battery. The gain to the State would be millions of pounds per annum, at present paid to foreign countries for petrol. Our central stations would be kept busy during the early hours of the morning in charging the traction batteries. It would lead to increasing the output of our central stations without increasing their capacity. Another help for reducing the price of electricity would be to educate consumers to reduce their bills by keeping down their maximum demands by using a special indicator.

### Electrical Equipment of Automobiles

THE electrical equipment of a motor-car is now an essential portion of the whole vehicle. This is proved in a paper by Mr. E. A. Watson (*J. Inst. Elec. Eng.*, March) describing the progress made during the last three years in the electrical equipment of cars. In the modern car, the driver should never be called upon to resort to hand-starting. The starter handle is carried separately in the tool kit, and in many designs can only be inserted with difficulty, its main function being to turn the engine round for adjusting purposes and not for starting. The ignition now is almost always by electric coil and not by a magneto. To assist the convenience in driving, electric petrol pumps, windscreen wipers and horns are used. Recently the remarkable progress made in the combined textile and rubber driving-belt has led to a reversion to the belt-driven dynamo. These are entirely satisfactory and have a normal life of 20,000 miles or more. This drive possesses the advantage of quietness and simplicity, as compared with the gear or chain drive. The modern head-lamps, designed with a parabolic reflector and a focused filament, produce a beam which is slightly divergent. By means of prisms, some of the light is diverted on to the sides of the road and some in front of the car. The anti-dazzle problem has been partially solved, but the greatest problem of all has been, and it looks as if it always would be, driving in fog. The only alleviation seems to be to use a fog lamp which throws the light directly downwards on the road. This eliminates any rays in an upward direction which might be reflected back to the driver's eyes.

### Discoveries at Sakkara

DISCOVERIES of great interest and importance are announced from Sakkara, where excavations are being carried on by the Egyptian Department of Antiquities under the direction of Mr. Walter Emery and Zaki Effendi Saad. These discoveries were made in a tomb of the first dynasty, which was partially excavated in 1931 and then appeared to have been completely rifled. Further excavation in the present season, however, in a series of forty-two store chambers in the superstructure of the tomb which previously had escaped notice, has brought to light the complete grave furniture of Hamaka, the Vizier of Pharaoh Den of the first dynasty (c. 3,000 B.C.). At present about half these chambers have been cleared. They have yielded a large number of objects. Among them are numerous jars for containing wine, which bear seals giving the names of Hamaka and his king, implements, such as wooden sickles with flint teeth, the wooden handles of large adzes, and a number of large flint knives of advanced technique, of which some are more than a foot in length. A quiver contains reed arrows with tips of bone or flint, and a spear has a head of ivory, while an inscribed ebony tablet bears the name of the Pharaoh Zer. Remarkable as are some of these objects, such as the flint knives, in coming from a tomb, the discovery is given a unique character by a large number of disks of stone, bronze or ivory, for which the excavators are as yet not prepared even to conjecture the purpose. Some of the disks are inlaid with different varieties of stone, and one showing hounds chasing a gazelle is in a style which is said to remind the observer of the products of Minoan art of some fifteen hundred years later.

### Road Testing

THE Department of Scientific and Industrial Research has just completed a road testing machine which is stated to be the largest of its kind in the world. According to *The Times* of April 8, road making and upkeep cost Great Britain about fifty million pounds a year, and thirty thousand pounds is being spent annually by the Department on research work on road engineering. The new testing machine consists of a 12-ton lorry, tethered to a central post by a 5-ton structural arm driven by a 180 horse-

power electric motor. It travels round a track 110 feet in diameter and wears two tracks on the test road. Its maximum speed is 40 miles an hour. Special safety devices have to be incorporated both in the design of the machine and of the building in which it is housed. If it broke away from the centre post when travelling at full speed, it would release energy equivalent to that of a six inch shell. The building containing the machine is roofed so that test roads may be laid in any weather. There are two other machines carrying out similar tests on a smaller scale. In the case of one of these machines the road revolves and drives the wheels, the maximum speed being nine miles per hour. A week's use of one of these machines sometimes represents a year's wear on the ordinary highway. It has been found out that the road generally wears out before the tyre gives way. Physical and chemical tests of roads and road making materials are also carried out at the laboratory. An appliance can bore out a cylindrical core of concrete from a road so that the texture and constituents of the mixture may be examined and its mechanical strength found. Tests on skidding are also made: theoretically, by a small apparatus in the laboratory which finds out the slipperiness of a lubricant, and practically, by means of a special motor cycle and sidecar.

### British Empire Cancer Campaign

AT the recent quarterly meeting of the Grand Council of the British Empire Cancer Campaign, a communication was received intimating that His Majesty the King had been graciously pleased to become patron of the Campaign. The following grants amounting to £5,530, and making a total to date of £30,990 for the year 1936, were approved: £1,100 to the Radium Beam Therapy Research; £1,750 (in addition to the grant of £1,850 already made for the year 1936) to the Mount Vernon Hospital; £500 (in addition to the grant of £600 already made for the year 1936) to the Marie Curie Hospital; £100 and £80 to Dr. C. R. Amies, at the Lister Institute and Dr. P. R. Peacock, of Glasgow, respectively, for the purchase of special types of centrifuges; £1,000 to the Manchester Committee on Cancer to cover the cost for two years of investigations to ascertain whether there is any connexion between the use of heavy oils in motor-vehicles and the apparent increase in the incidence of cancer of the upper air passages and the lung; £1,000 to the North of England Branch of the Campaign to meet the cost for the second year of the short-wave investigations being carried out at Newcastle, on behalf of the Campaign, under the direction of Prof. W. E. Curtis and Dr. F. Dickens. In this connexion the Council expressed its appreciation of the technical assistance afforded the workers by the technical staff of the Marconi Company. The Royal Society and the Medical Research Council have nominated Prof. Matthew Stewart, of the University of Leeds, to succeed Prof. R. T. Leiper, who has retired, as one of their five nominees on the Scientific Advisory Committee of the Campaign.

### A New Hydraulic Laboratory

HYDRAULIC laboratories are in use for a variety of purposes, including the training of engineers, tests of turbines and pumps, model experiments on ships and seaplane floats and for research on river, reclamation and harbour problems. In the *Engineer* of April 3, Dr. F. V. A. E. Engel reviews some of the aspects in the design of such laboratories and gives a detailed description of the new hydraulic laboratory at the Park Royal works of Messrs. Electroflo Meters Co. Ltd., erected for the routine work of testing and calibrating meters and for the development and improvement of fluid flow measuring devices. A factor of importance in the design of a meter test plant, he says, is the maintenance of a constant head in the test line. In the plant at the Park Royal works, water is drawn from a sump by two electrically driven centrifugal pumps and delivered to an overhead tank 65 feet above the ground floor. The water then flows through the test line, where Venturi tubes and orifice plates may be installed in a straight pipe 60 ft. long. From the test line the water passes into a settling tank and two measuring tanks, and so back to the sump. For timing the tests an interesting device has been adopted which automatically operates the stop watch. When the flow of water entering one measuring tank is switched over to the other, the water jet from the change-over valve interrupts a beam of light impinging on a photo-electric cell, and by means of a thermionic amplifier and relay the stop watch is controlled. In the new laboratory, investigations are in progress on a model of a large Venturi flume recently constructed at the West Middlesex sewerage works at Mogden.

### Botanical Acquisitions at the Natural History Museum

CAPT. F. KINGDON-WARD has presented more than 1,100 specimens collected on his recent expedition to Tibet to the Department of Botany of the British Museum (Natural History). Mr. R. F. Jones has made a collection of plants during the Percy Sladen Expedition to Lake Hula. The lake and its adjacent swamp, an area of about seventeen square miles, was concentrated upon, as the flora will disappear with drainage, and the flora of the hills of Palestine is fairly well known. The collection is of more than four hundred numbers and includes all groups. The investigation was mainly ecological, but the collection contains several new records of flowering plants. Lieut.-Colonel F. M. Bailey, British Envoy Extraordinary and Minister Plenipotentiary at Katmandu, Nepal, has presented 488 flowering plants and 42 vascular cryptogams. These make a useful addition to the valuable Nepalese collections already in the Department.

### Indian Helminths

G. D. BHALERAO has prepared a list of the helminth parasites hitherto recorded from domesticated animals in India (Imperial Council of Agricultural Research. Scientific Monograph No. 6. Pp. 365. Delhi, 1935. 13*s*. 3*d*.). A brief account of the technique of collecting, preserving and preparing the parasites for

examination precedes the systematic account, which is provided with the usual keys and with illustrations to facilitate identification and to show structural features. The illustrations are for the most part satisfactory, but the author's photograph of a much distorted transverse section of *Parascaris equorum* could have been omitted. The memoir will be helpful to those who are interested in the helminths of Indian domestic animals. It is marred by a considerable number of misprints which necessitated the addition of a slip correcting more than fifty errata. One of those is "for Linneas read Linnaes" and on reference to the page cited we find "Linneas 1858" which should, of course, be "Linnaeus, 1758"; more care in reading the proof would have been well repaid in the result.

### Fungi of South Australia

THE South Australian Branch of the British Science Guild is making a determined effort to interpret the flora and fauna of the southern parts of Australia to students of biology in that region. It has on one hand the sympathy and active financial support of the South Australian Government, and on the other hand the authors of a series of handbooks, who prepare their manuscripts gratuitously. The latest volume to be added to this list is the second part of "Toadstools and Mushrooms and other Larger Fungi of South Australia" (Adelaide: Govt. Printer. 5*s*. net. Pp. 177–362. June 1935). Prof. J. B. Cleland, who is also chairman of the Committee responsible for the handbooks, has written the volume, which deals with polyporous and coral fungi, with puff-balls, jelly-like fungi, and the larger Ascomycetes and Myxomycetes. The volume forms, with Part 1 (published in June 1934), a complete guide to the grosser fungi of the area mentioned in the title, and it is no fault of the author that the Hymenomycetes are in great preponderance. Ascomycetes receive somewhat scant treatment upon five pages, whilst Myxomycetes receive slightly less, but the treatment of the Basidiomycetes should make the volume into a mycological classic. The classification adopted is a combination of the systems propounded by Carleton Rea and P. Claussen. It is easy to follow, though a purely English reader might have preferred to see either the modern thoroughness and authoritative dignity of Rea, or the comprehensive well-tried simplicity of Claussen, adopted throughout.

### Aims and Methods of Medical Science

THIS was the title of the inaugural lecture delivered on November 26 by Prof. John Ryle, the new regius professor of physic at Cambridge, and now available in attractive book-form (Cambridge University Press, 1935, 2*s*. net). Prof. Ryle reviews the scope and present shortcomings of medical science, and concludes that among the great body of practitioners and laboratory workers there is too large a proportion whose standards of accuracy are defective, and whose judgment is crippled. These shortcomings are ascribed to three primary errors: (1) faulty selection of men, or misdirection of their energies after qualification; (2) complicated and unwieldy systems of education and examination; and (3) the spread of the cult of specialism. Prof. Ryle does not condemn specialism as such, "for good specialism is essential to all scientific progress"; but condemns only excessive, premature and misdirected specialisms for the subversive influences which they have had upon medical thought, action and education. In seeking a remedy, Prof. Ryle reviews some of the recent achievements in medicine, and finds that the clinician has himself experimented, or that there has been intimate collaboration between experimenter and clinician. Observation and experiment are both essential, but they must go hand in hand. Prof. Ryle envisages that in the future the younger men will turn more frequently to the study of problems at the bedside, and that a happier partition of problems and a closer collaboration between the wards and the laboratory, between students of normal and students of morbid physiology, than obtains at present, will play their part.

### Report of the Rockefeller Foundation

ACCORDING to the annual report which has recently been published, the Rockefeller Foundation expended 12,679,775 dollars during the year 1934. In public health, field researches were undertaken on yellow fever, malaria, hookworm disease, tuberculosis and several other diseases, and the organisation and maintenance of essential State and national health services in various parts of the world were promoted. In the medical sciences, many university departments and others received aid for psychiatry, and the Lister Institute funds for the purchase of an ultra-centrifuge. In the natural sciences, grants were made for promoting experimental biology and genetics, physiology and endocrinology. In the social sciences, the largest grant went to the Welfare Council of New York City, and several universities, including Oxford, and other bodies, received support. In the humanities, grants supplementing former assistance were made to the Bodleian Library and the Bibliothèque Nationale in Paris, and the Foundation appropriated funds for the "Dictionary of American Biography", the "Historical Dictionary of American English", and the "Virginia Historical Index"—works now in course of preparation.

### Reports of the Smithsonian Institution, Washington

THE annual reports for 1933 and 1934 of the Smithsonian Institution of Washington, both of which have recently been received, give details of the operations and expenditures during the sessions in question (Superintendent of Documents, Washington, D.C. 1 dollar). In both volumes, reports are given summarising the year's activities, finances, grants, publications, library, etc. These are followed by detailed reports which include those of the Bureau of American Ethnology, National Zoological Park, Astrophysical Observatory, Division of Radiation and Organisms, International Catalogue of Scientific Literature and the International Exchange Service. The greater part of each volume is, however, used

for the publication of articles and addresses by well-known men of science, most of which have already appeared in previous publications such as *Philosophy, Technology Review, Geographical Journal, Scientific Monthly*, Report of the British Association, *Science Progress*, NATURE, etc. This general appendix of well-chosen lectures, addresses and papers adds greatly to the value of these annual reports.

### The Pacific Science Congress

THE Report for the year 1933–34 of the National Research Council of Japan contains the resolutions passed at the Fifth Pacific Science Congress held in Victoria, B.C. and Vancouver in June 1933. Steps were taken to secure more accurate information as to the depth, salinity and temperature of the ocean, the life conditions of halibut, salmon and whales in it and to prevent the discharge of oil from vessels on it. Plant diseases and parasites of the cereal crops and timber grown on the coasts and mountain ranges bordering them are to be studied more thoroughly, atmospheric circulation is to be investigated by pilot balloons, and the necessity of continuing magnetic, electric and oceanographic work by means of a new non-magnetic ship to replace the lost *Carnegie* was emphasised. Seismological information is to be spread by wireless as soon as it is available.

### Principles of Field Experimentation

THE Empire Cotton Growing Corporation has recently issued a volume of one hundred pages entitled "Principles and Practice of Field Experimentation", by J. Wishart and H. G. Sanders of the School of Agriculture, Cambridge. This is really the third edition of the volume, the first two, written by Engledow and Yule, having appeared in 1926 and 1930 respectively. Perhaps the most important improvements in method in the last ten years are the recognition of the usefulness of the factorial type of design, the confounding of main effects and high order interactions, the analysis of covariance and the fruits of many studies on sampling technique with cereals and root crops. Except for confounding, which is considered by the authors to be beyond the scope of the book, these topics are dealt with in this volume in a very readable manner. The section on practice contains much good advice on the planning and carrying-out of a field experiment, and is particularly welcome in that it answers many of the objections which have been raised by the so-called 'practical' man to modern methods of field experimentation.

### Statistical Abstract for the British Empire

PROBABLY the most generally useful statistical publications issued by H.M. Stationory Office are the various Statistical Abstracts, such as the Statistical Abstract for the United Kingdom, the Abstract of Labour Statistics and the Statistical Abstract for the British Empire. The sixty-fourth number of the last named has recently been published (H.M. Stationery Office, 3*s*. 6*d*.) and contains a great wealth of statistical information relating to the exports and imports of the various Dominions, Colonies and Dependencies for each of the ten years 1925–34. It is, however, less complete than previous issues, which also included information relating to finance, production, prices, etc., but it is intended to publish the Abstract in complete form in alternate years. Those who have frequent occasion to refer to statistical data will find this and the other Statistical Abstracts invaluable as a means of obtaining convenient summaries of official statistics drawn from very varied sources.

### *Science Abstracts*

THE issue of the index parts completes vols. 38 of *Science Abstracts* for 1935. The physics volume extends to 1,569 pages, 315 of which are occupied by a detailed subject index and key, and a name index. The electrical engineering volume has only 899 pages, 157 of which are index. Both are about the same size as the corresponding volumes last year. The average length of an abstract continues to be a little less than a quarter of a page, which experience seems to show is sufficient to allow an expert to give the gist of a paper, and allow a reader to keep abreast of research work in his own and kindred fields.

### Memorial to X-Ray Workers

A STONE memorial to a hundred and sixty medical men, physicists, chemists, laboratory workers and nurses whose deaths were due to working with X-rays, was unveiled on April 4 at St. George's Hospital, Hamburg. The countries represented on the memorial are Germany, France, Great Britain, the United States, Italy, Hungary, Switzerland, Austria, Denmark, Czechoslovakia, Spain, Belgium, Finland, Russia and Holland. The British names inscribed are R. G. Blackall, C. R. C. Lister, Melville H. Walsham, C. Williams, E. E. Wilson, W. H. Fowler, J. S. Hall-Edwards, J. W. L. Spence, J. R. Riddell and W. I. Bruce Pirie.

### Announcements

HIS MAJESTY THE KING has been graciously pleased to grant his patronage to the Iron and Steel Institute. The Institute was similarly honoured by the late King George and by King Edward VII before him, both of whom had previously shown their interest in the Institute's activities by consenting to accept honorary membership. His Majesty King Edward VIII was also an honorary member until his accession to the throne.

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Sir William Bragg at the ordinary meeting of the Institution to be held on Thursday, April 23, at 6 p.m. The presentation will precede the twenty-seventh Kelvin Lecture, which will be delivered by Dr. J. D. Cockcroft, on "The Transmutations of Matter by High-Energy Particles and Radiations".

THE following have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service: Mr. Henry Balfour, curator of the Pitt-Rivers Museum, Oxford, and Dr. W. D. Ross, provost of Oriel College and University lecturer in philosophy, Oxford.

THE RIGHT HON. THE EARL OF ATHLONE, Chancellor of the University of London, will open the new High Voltage Laboratory at Queen Mary College, London, on Wednesday, May 6, at 3.30 p.m.

DR. J. T. IRVING, lecturer in physiology at the School of Medicine, University of Leeds, has been appointed head of the Physiology Department of the Rowett Research Institute in succession to Dr. R. C. Garry, who has accepted the chair of physiology in the University of St. Andrews.

DR. ANTOINE BÉCLÈRE of Paris, formerly professor of clinical medicine in the University of Paris, the nestor of röntgenology, celebrated his eightieth birthday on March 17.

IT is announced in *Science* that Prof. Franz Boas, who has been professor of anthropology in Columbia University since 1899, will retire on June 30 at the age of seventy-eight years.

MR. C. C. PATERSON will deliver the twenty-sixth annual May Lecture of the Institute of Metals on May 6 at 8 p.m., in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. The subject of the lecture will be: "The Escape of Electricity from Metals: its Practical Consequences".

ON the occasion of the twenty-fifth anniversary of the publication of the first edition of Ramon Turro's work on "The Origins of Knowledge", the Barcelona Society of Biology has offered an international prize of 2,000 pesetas for the best original and unpublished essay containing a critical study of Turro's scientific work. The essay, which may be in Catalan, Castilian, French, English, German or Italian, should be sent to the Secretary of the Society, Calle del Carmen 47, Barcelona, before May 25.

THE *Proceedings and Transactions of the South London Entomological and Natural History Society* for 1934–35 form a record of a successful year's activities. In addition to the accounts of the field and other meetings, together with annual reports, etc., the journal contains a number of articles written by various members of the Society. These contributions cover a wide range of subjects bearing upon insect life, and are of interest to the naturalist and student alike. The presidential address, by Mr. T. R. Eagles, dealing with the subjects of "Mendelism, Mimicry and Colour Conflict" is also included in the volume.

OWING to the present state of world affairs, the second International Congress of Mental Hygiene, which was to have been held in Paris next July, has been postponed until July 1937, when an international exhibition will be held in Paris. The exact date is not yet fixed, but it will probably be July 19 or 26.

THE International Health Division of the Rockefeller Foundation wishes to obtain strains of virus from different outbreaks of influenza in order to compare their immunological properties in a study now in progress. Health authorities are requested to notify Dr. Johannes H. Bauer, Rockefeller Institute, York Avenue and 66th Street, New York.

THE second International Congress of the World Fellowship of Faiths will be held in London on July 3–18. The subject of the Congress will be "World Fellowship through Religion". The international president is H.H. The Maharaja Gaekwar of Baroda, and the chairman of the British National Council is Sir Francis Younghusband. Further information can be obtained from the Organising Secretary, Mr. Arthur Jackman, 17 Bedford Square, London, W.C.1.

THE fourth International Congress for Experimental Cytology will be held in Copenhagen on August 10–15. The Congress will consider the following subjects; physical chemistry of the cell; histochemical problems and cell metabolism; experimental morphology; electrophysiology of the cell; experimental cell pathology and biology of irradiation. Further information can be obtained from the secretary of the Congress, Dr. Harald Okkels, Institute for Pathological Anatomy, 11 Frederik 5' Vej, Copenhagen, Denmark.

THE eighth International Medical Postgraduate Congress of the Tomarkin Foundation, New York, which has been organised under the auspices of the University of Athens in co-operation with the Greek Ministry of Health, will be held at Athens under the presidency of Prof. Dustin, rector of the University of Brussels, on September 7–21. Lectures will be delivered on cardio-vascular diseases, surgery, tropical medicine and infectious diseases, dermatology, endocrinology and tuberculosis. During the Congress homage will be paid to the memory of Manson, Ross, Laveran, Golgi and Marchiafava, whose researches contributed to the solution of the problem of a successful campaign against malaria. A special steamer will leave Marseilles for Athens on September 2 or 3. Further information can be obtained from the Tomarkin Foundation, 97 rue aux Laines, Brussels.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, 10 Whitehall Place, S.W.1 (April 27).

A chemical assistant in the Public Health Department of the London County Council—The Clerk to the Council, County Hall, Westminster Bridge, S.E.1 (May 4).

# Letters to the Editor

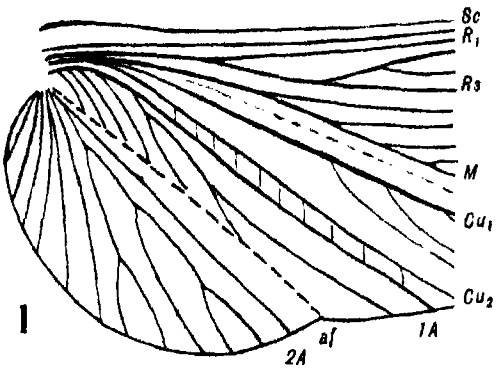
*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 664.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Are Termites Descended from True Cockroaches?

MANY authors have given their opinion that the termites or white ants are nothing more than socialised cockroaches; but, so far, definite proof to this effect has been entirely lacking. The nearest approach to any scientific theory of descent is that of Crampton[1], in which the author concludes that the termites come nearest to cockroaches in their morphology and are probably descended from some very remote ancestor, but not from true cockroaches.



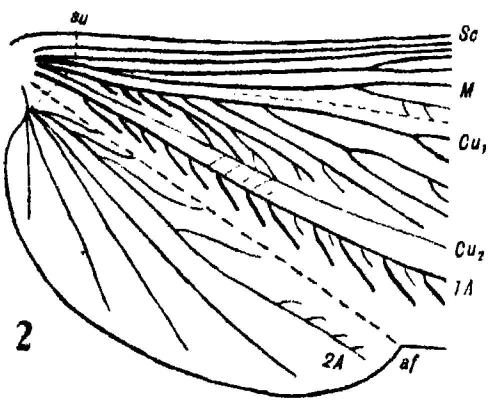




FIG. 1. *Pycnoblattina* sp., hindwing (basal half): Lower Permian of Kansas. FIG. 2. *Mastotermes darwiniensis*, Frog. Recent. North Australia. Usual notation for veins; *af*. anal fold; *su*, humeral suture.

It is universally admitted that *Mastotermes*, the giant termite of northern Australia, is the most archaic type by far within the order. Hence a grave difficulty in deriving termites from any other type of insects has been the peculiar method of folding of the hindwing in *Mastotermes* (Fig. 2). Alone among termites, this genus possesses a definite anal lobe, which is not homologous with the anal fan of other Orthopteroids, since it is not the complete anal area, folded about a convex groove between $Cu_2$ and $1A$, but merely includes that portion served by vein $2A$ and its branches, and folds about a groove (*af*) lying between $1A$ and $2A$.

The cockroaches, on the other hand, have a complete anal fan which folds in the usual Orthopteroid manner; in addition, that portion served by vein 2A folds up concertina-wise, and lies like a folded fan against vein $1A$, under the rest of the wing. As it is clear that the cockroach condition is far more specialised than that of *Mastotermes*, it would seem impossible to derive the termites from cockroaches.

A fortunate discovery in the rather small cockroach fauna of the Kansas Lower Permian has enabled me to solve this problem. Among the material studied, I have found a hindwing of the genus *Pycnoblattina* (a true cockroach of the family Spiloblattinidæ) in which the anal area is completely preserved (Fig. 1). It will be seen at once from Figs. 1 and 2 that, not only is the anal lobe developed and folded exactly as in *Mastotermes*, but also a close correspondence extends to many other details of the venation. In fact, I would go so far as to claim, from this comparison alone, that *Mastotermes*, and therefore the whole order Isoptera, must have been evolved from a form differing very little from the genus *Pycnoblattina* itself. The chief lines of specialisation by which the Isoptera have been evolved are: reduction of the pronotum, lengthening of the wings, reduction of the anal area of the forewing, narrowing of the basal parts of the wing, and development of the humeral suture (Fig. 2, *su*), along which the wings are cast off when shed.

We now see that it is the cockroaches which have gone ahead, since Permian times, in the development of the mode of folding of the hindwing, while the termites at first 'stayed put', like *Mastotermes*, and later eliminated the anal lobe entirely.

R. J. TILLYARD.

Canberra,
Australia.
Feb. 3.

[1] *Bull. Brooklyn Ent. Soc.*, 18, 85-93 (1923).

## The Oil-Drop Method and the Electronic Charge

FOR several years it has seemed to us to be of interest to repeat the oil-drop method in order that this method may have an opportunity of contributing to the building up of the new value of the electronic charge, which is now going on. The only existing prototype, the famous oil-drop experiments of Millikan in 1913 and 1916, seems to predict an internal consistency somewhat less than that of the new spectroscopic X-ray and electron-wave[1] methods.

The first step in this direction was taken by Kellström[2] when he re-measured the value of the viscosity of air ($\eta$), which is fundamental for this method.

We have now had the opportunity of performing some preliminary investigations by the oil-drop method. We wish to point out that the variations in velocity of the drops between the condenser plates are real, and therefore long series of observations are necessary to get the mean value free from influence of the Brownian motion. During this time it is necessary that the conditions should be as constant as possible, that is, the evaporation of the drops must be reduced to a minimum. For this purpose we have used Apiezon *B* oil with very good results.

In order to make the extrapolation for the $[e_1^{2/3}, \frac{1}{pr}]$ diagram as small as possible (the correction amounts to about 10 per cent in $e$ for 1 atm.), it is of advantage to perform measurements also at pressures greater than 1 atm. Consequently the small preliminary apparatus was constructed for higher pressures. The measuring procedure—we have made observations up to 15 atm.—involves no difficulties. However, the resulting $e_1^{2/3}$-values showed a remarkable decrease from the straight line even at 5 atm., due to the increasing value of $\eta$ with increasing pressures[3]. There are two ways of making the higher pressures useful for the method: first, to measure $\eta$ at those pressures with the usual methods, and secondly, to perform the measurements with oil-drops of different radii at a number of different constant pressures, each pressure giving a straight line, and then apply an empirical procedure of a similar character to that used for the correction due to the invalidity of Stokes's law. Perhaps this may be also a method of determining the relative increase of $\eta$ at higher pressures.

To show the possibilities of the apparatus, the following preliminary results may be of interest. These include *all* the nine drops taken at 1 atm. Up to 260 velocity observations during a period of 3 hours have been taken on one drop.

| $p$ (cm.Hg, 0°) | $\frac{1}{pr}$ | $e_1^{2/3} \times 10^{8}$ | $e \times 10^{10}$ |
|---|---|---|---|
| 76·13 | 72·73 | 63·66 | 4·760 |
| 76·14 | 78·28 | 63·75 | 747 |
| 75·92 | 87·01 | 64·10 | 748 |
| 76·89 | 87·65 | 64·23 | 761 |
| 76·93 | 96·27 | 64·57 | 764 |
| 75·82 | 105·08 | 64·85 | 758 |
| 76·84 | 126·63 | 65·68 | 762 |
| 76·89 | 133·14 | 66·07 | 778 |
| 76·93 | 158·00 | 66·65 | 741 |
| | | Mean | 4·7577 |

Average deviation from the mean $\pm 0·008$ (2/3 of that of Millikan, 1916). $r$ is computed in the usual manner with $e = 4·80 \times 10^{-10}$, and $e_1^{2/3}$ with $\eta_0 = [182·27 - 0·493\ (23-\theta)] \times 10^{-6}$ C.G.S. units, $c = 3·000 \times 10^{10}$ cm./sec., $g = 981·9$ C.G.S. units. The least square method gives $b = 0·000609$, which is used for the values of $e$ in the last column.

Condenser plates, diameter, 5 cm.; distance, 0·3787 cm. Distance of fall, 0·25597 cm. Density of oil, 0·8688 gm./cm. Times of fall, 7–33 sec. Number of charges, 2–9. Voltage about 750 volts.

The voltage (in international volts) was measured with a Wolff 5-decade compensating apparatus against a Standard Weston Cell which has been controlled for several years. The time observations were made by means of a 0·01 sec. stop-watch calibrated against a standard pendulum clock. Reduced to $c = 2·9979 \times 10^{10}$ cm./sec. and abs. volts, the resulting value of $e$ comes out as $4·752 \times 10^{-10}$ abs. E.S.U. With Kellström's new value of $\eta$

$$e = 4·800 \times 10^{-10} \text{ abs. E.S.U.},$$

in very good agreement with the spectroscopic values. As the errors in the constants used (*except for* $\eta$) are small relative to the average deviation from the mean (see table) the latter may be considered a true measure of the accuracy.

Further refinements of the apparatus are in progress and a detailed report will be given later. Our thanks are due to Ina Wennerlöf-Bäcklin, who has carried out the oil density measurements.

ERIK BÄCKLIN.
HARALD FLEMBERG.

Physics Laboratory,
University,
Uppsala.
Feb. 29.

[1] Sten von Friesen, Uppsala Univ. Årskr., 14 (1935).
[2] Gunnar Kellström, NATURE, 136, 682 (1935).
[3] Wien, Harms, "Handb. Exp. Phys.", IV, 4, 523 (1932).

## Electrical Evidence on Calcite Imperfection

IN view of the recent letter of Birge[1] concluding that the one remaining large discrepancy in the values of the fundamental physical constants is traceable to *either* geometrical imperfection in calcite *or* an error in Bohr's formula for the Rydberg constant, all evidence of imperfection in calcite becomes highly important.

Such evidence is provided by the work of Joffé and his associates on electrical conduction in calcite[2,3]. They found that there is gradually built up a very large polarisation voltage, due to a space charge concentrated in a layer of the crystal less than 1 μ thick adjacent to the cathode. Outside this region the field strength remains uniform and relatively very low. Joffé argued that this indicates a depletion of charge carriers at the cathode, and that they must therefore be negative. At somewhat higher temperatures actual transport number measurements show that the whole of the current is carried by calcium ions.

Joffé supposed that the negative charge carriers responsible for conduction at low temperatures were impurities. This change of mechanism is improbable, since the temperature variation of conductivity of calcite follows the normal law ($\log \sigma = -A/T + B$) with the slope characteristic of electrolytic conduction in heteropolar crystals[3,4]. It is more in harmony with the experimental results and with modern views on the structure of solids to suppose that these negative charge carriers are cation absences, lattice positions which should be but are not occupied by $Ca^{++}$ ions. These migrate by receiving neighbouring $Ca^{++}$ ions, more frequently from the anode side than any other. It is almost inevitably easier for this to happen than for an ion foreign to the lattice to thread its way through where there is no room for it: calcite shows none of the properties of electronic conduction. There must be an equal number of anion absences, which are not mobile.

On this view, the depletion of charge carriers at the cathode becomes an approach to occupation of all available cation positions: alternatively stated, a removal of most of the mobile cation absences. They are not necessarily all equally mobile; on the contrary, anion absences will attract them, and it will require considerable energy to dissociate an adjacent pair of oppositely charged absences. Both the concentration and mutual distribution of anion

absences will be important in determining behaviour: both are probably frozen-in equilibria characteristic of some higher temperature. Thus various samples may have very different properties depending on past thermal history.

It is possible to calculate a lower limit to the concentration of absences in calcite from the figures given by Joffé. There is a potential distribution in the polarisation layer according to the law:

$$V = V_0 e^{-x/D}.$$

Hence the space charge density is

$$\rho = \frac{\varepsilon}{4\pi}\frac{d^2V}{dx^2} = \frac{\varepsilon V_0}{4\pi D^2} e^{-x/D}.$$

The value of $D$ remains constant for a given specimen at about $4 \times 10^{-5}$ cm. up to a polarisation potential $V_0$ of about 2,000 volts. The maximum space charge density is then:

$$\begin{aligned}\frac{\varepsilon V_0}{4\pi D^2} &= (8\cdot3 \times 2 \times 10^{13})/(4\pi \times 4^2 \times 300) \text{ E.S.U./cm.}^3\\ &= 2\cdot75 \times 10^9 \text{ E.S.U./cm.}^3\\ &= 2\cdot88 \times 10^{18} \text{ Ca}^{++} \text{ ions/cm.}^3\end{aligned}$$

Since there should be about $1\cdot64 \times 10^{22}$ molecules per cm.$^3$ in a perfect crystal of calcite, this indicates a deficiency of 0·018 per cent. This refers to mobile absences only, and is a lower limit. Polarisation potentials of more than 7,000 volts have been observed, though with somewhat increased values of $D$. Even so, this is six times Bearden's probable error for the density of calcite[5], and 1·7 times the probable error of the 'grating value' of $e$, though only 4 per cent of the major discrepancy in $e$-values. Hence it appears that this type of imperfection in calcite, estimated as a lower limit, introduces a significant correction in the determination of the charge of the electron, but it only increases the major discrepancy.

F. C. FRANK.

Engineering Laboratory,
Oxford.
Feb. 11.

[1] R. T. Birge, NATURE, **137**, 187 (Feb. 1, 1936).
[2] A. F. Joffé, "The Physics of Crystals" (1928).
[3] A. F. Joffé, *Ann. Physik* (4), **72**, 478 (1923).
[4] B. Gudden, *Ergebnisse der Exakten Naturwissenschaften*, **3**, 134 (1924).
[5] J. A. Bearden, *Phys. Rev.*, **38**, 2089 (1931).

## Use of a Geiger-Müller Counter for the Study of the Diffraction of X-Rays by a Gas

PHOTOGRAPHIC records of X-rays diffracted by a gas require long times of exposure. This feature suggests the interest of replacing the photographic plate by a Geiger-Müller counter.

We have succeeded in determining the diffraction curve of molybdenum $K\alpha$ rays by gaseous carbon tetrachloride with the same precision as with a photographic method. The radiation (50 kilovolts, 20 milliamperes) was filtered through a 0·2 mm. thick plate of zirconium. In these circumstances, it was practically monochromatic, as has been shown lately in this laboratory by J. Piérard. Relative intensities were determined from the measurements of times necessary for the production of a constant number (500) of discharges in the counter (Fig. 1). Special care was taken during the measurements in order to avoid influences of slow variations in the apparatus used. The angles of diffraction corresponding to maxima and minima of intensities as well as to inflection points are given in the accompanying table, together with the Cl—Cl distances deduced from these measurements.

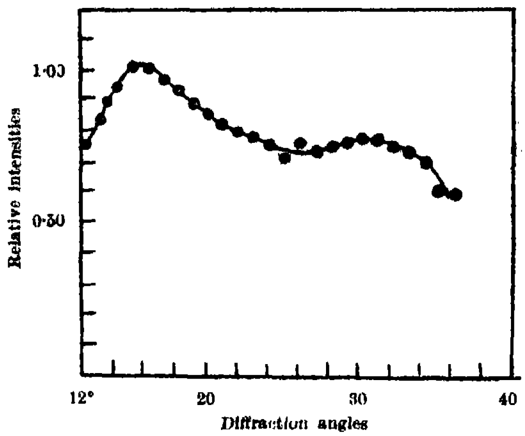


FIG. 1.

As may be seen, the agreement between the mean value 2·83 A. and that (2·85 A.) found by Degard, Piérard and van der Grinten[1] is very satisfactory.

| | Angles | Cl—Cl distances |
|---|---|---|
| 1st maximum | 16° 10′ | 2·90 A. |
| Inflection point | 21° 10′ | 2·82 A. |
| 2nd minimum | 25° 50′ | 2·82 A. |
| Inflection point | 28° 50′ | 2·78 A. |
| 2nd maximum | 31° 00′ | 2·84 A. |
| | Mean value | 2·83 A. |

A more detailed account of this research is to be published later. We wish to thank Prof. P. Debye, under whose direction this work was carried out.

W. VAN DER GRINTEN.
H. BRASSEUR.
Laboratoire du Fonds Francqui 1934–1935,
Université de Liége.

[1] C. Degard, J. Piérard and W. van der Grinten, NATURE, **136**, 142 (1935).

## *Orientation in Peritectic Structures*

PRELIMINARY results from an X-ray study of the peritectic reaction $\alpha$ + liquid $\rightarrow \beta$ in the Cu-Zn system prove that the orientations assumed by the $\beta$-phase are definitely related to the orientation of the $\alpha$-phase. Specimens suitable for accurate orientation studies (by means of back-reflection Laue patterns) were prepared by solidifying a pure $\beta$-alloy (52 per cent copper) under a uniform temperature gradient, and seeding the crystallisation with a copper single crystal. The resulting specimens then consist (in order, from bottom to top) of (*a*) copper crystal seed, (*b*) primary crystallised $\alpha$-phase having the same orientation as the copper seed, (*c*) large $\beta$-grains (2–5 mm.), the nuclei of which originated in the peritectic reaction $\alpha$ + liquid $\rightarrow \beta$; these $\beta$-grains have a narrow rim of segregated $\alpha$-phase. This sequence

of crystallisation is made possible, as was expected, by the diffusion of copper into the liquid β-brass adjacent to the solid copper crystal.

The orientation of the individual copper and β-brass crystals was determined by means of the back-reflection Laue X-ray method, with an accuracy of $\pm 0{\cdot}5°$ or better. To date, only two (of twenty) β-brass crystals have been found with a relationship accurate to within 1°:

$$(110)_\beta \text{ parallel to } (111)_{\text{copper}} \qquad [110]_\beta \quad ,, \quad [112]_{\text{copper}} \quad . \quad . \quad (1)$$

The orientations of all the β-brass crystals approximated to this relationship within a few degrees. The average deviation was about 3°. It is worthy of note that although an approximate α β relationship does exist, the relationship is never *exact*. Possibly the matching of atomic planes and atom directions in those planes is not the governing factor which determines the orientations assumed by the β-phase.

Relationship (1) is the same as that determined by Nishiyama[1] and Wassermann[2] for the decomposition of Fe-Ni austenite.

ALDEN B. GRENINGER.

Laboratory of X-Ray Metallography,
Graduate School of Engineering,
Harvard University,
Cambridge, Mass.

Feb. 1.

[1] *Sci. Rep. Tôhoku Imp. Univ.*, iv, **23**, 637 (1934).
[2] *Mitt. Kaiser-Wilh.-Inst. Eisenforsch.*, **17**, 149 (1935).

## Sign of the Magnetic Moment of the Proton and of the Deuteron

THE experiments of Stern, Estermann and Frisch, which were later corroborated by us, show that the magnetic moment of the proton is about three nuclear magnetrons. This large value indicates that the theory which accounted for the electron moment will not suffice for the proton. Further, it is well known that deflection experiments are incapable of giving an indication of the sign of the nuclear moment. In the absence of a quantitative theory, this property of the proton and of the deuteron therefore becomes a matter of assumption.

We have succeeded in devising a method of making this observation of the sign which involves the use of non-adiabatic transitions in a weak rotating magnetic field: A beam of neutral hydrogen (deuterium) atoms is first deflected in a weak inhomogeneous magnetic field and then in a strong inhomogeneous field arranged to produce deflections in the opposite direction. For suitable values of the first field, it is then possible to focus atoms of all velocities in a given magnetic level on the slit of the Stern-Pirani detector. In a magnetically shielded region between the two fields is placed a set of wires carrying current which produce weak, rapidly varying magnetic fields to induce non-adiabatic transitions between the different magnetic levels. A movable selector slit allows one to sort out the atoms of positive overall moment from those with negative overall moment which have the same magnitude. On examining the moments from the two $m = 0$ levels of hydrogen, it was found that the atoms in the state with negative overall moment were capable of making the transitions, but those with positive overall moment were not. Since no transitions between the $F = 1$ and $F = 0$ levels are produced with the method, the state with positive overall moment has $F = 0$; the hyperfine structure multiplet is normal, and the magnetic moment of the proton is positive. Similar experiments with deuterium show that the deuteron moment is also positive.

Full details will appear elsewhere.

J. M. B. KELLOGG.
I. I. RABI.
J. R. ZACHARIAS.

Dept. of Physics,
Columbia University,
New York City.

## The New Electrodynamics and the Fine Structure Constant

THE new electrodynamics put forward by M. Born[1] changes the form of Maxwell's equations. The question arises, whether this generalisation is the only one which gives a finite mass for an elementary particle and becomes, for weak fields, the Maxwellian equations.

Starting from a new form of the variational principle[2], it is possible to show that, by accepting quite obvious assumptions, there exists a group of action functions, depending on a parameter, say β, which leads for every $\beta > 0$ to a unitarian field theory, fulfilling both the conditions; that is, giving finiteness of energy and Maxwell's equations as a limiting case. Born's action function corresponds to $\beta = 1$. The choice between all the different theories can be made only by applying criterions arising from the further development of the theory. A very simple theory corresponds to the limiting case $\beta = 0$. The Lagrangian takes in this case the form (for the sake of simplicity we assume that $L$ is dependent only on $F$):

$$L = \tfrac{1}{2}\log(1 + F) = \tfrac{1}{2}\log(1 + \vec{B}^2 - \vec{E}^2) \quad . \quad . \quad . \quad . \quad (1)$$

Calculating the mass $m$ of an elementary particle, we find in natural units (in which $e = 1$, $c = 1$, $b$ = absolute field $= 1$):

$$m = \sqrt{\tfrac{5}{6}} \times 1{\cdot}2361 \quad . \quad . \quad . \quad . \quad (2)$$

slightly different from the value 1·2361 obtained in Born's theory.

Heisenberg and Euler and Kockel[3] have shown that the scattering of light by light can be expressed as a result of non-linear correction terms to Maxwell's equation, corresponding to a Lagrangian (still in natural units):

$$L = \tfrac{1}{2}(\vec{B}^2 - \vec{E}^2) - \frac{1}{90\pi}\,\frac{1}{m^4}\,\frac{1}{\alpha}(\vec{B}^2 - \vec{E}^2)^2 + \ . \ . \ . \quad (3)$$

α being the fine structure constant. Putting in (3) the value (2) for $m$ and comparing it with the Lagrangian (1)

$$L = \tfrac{1}{2}(\vec{B}^2 - \vec{E}^2) - \tfrac{1}{4}(\vec{B}^2 - \vec{E}^2)^2 + \ . \ . \ . \ . \ ,$$

we can calculate $1/\alpha$, and find $1/\alpha = 130$, which is close to 137, whereas Born's theory gives $1/\alpha = 82$.

L. INFELD.

University, Lwów.

Feb. 18.

[1] M. Born, *Proc. Roy. Soc.*, A, **143** (1934); M. Born and L. Infeld, *Proc. Roy. Soc.*, A, **144**, 425 (1934).
[2] L. Infeld, *Camb. Phil. Soc.* (in the press).
[3] Heisenberg and Euler, *Z. Phys.*, **98**, 714 (1936); Euler and Kockel, *Naturwiss.*, **23**, 246 (1935).

## Deviations from the Maxwell Equations resulting from the Theory of the Positron

IN spite of its well-known inconsistencies, Dirac's theory of the positron enables one to calculate some physical processes in an unambiguous way; for example, pair creation by photons or by charged particles. Another consequence of this theory, which results from it unambiguously, is the coherent scattering of light by electrostatic fields. It is easily shown that in the latter problem no divergencies occur. The calculation of the polarisability of the vacuum or of scattering of light by light, however, leads to divergent series. To avoid this, Dirac and Heisenberg[1] suggested a convention which allows these infinite expressions to be subtracted.

Owing to the arbitrariness of this formalism, its quantitative results are open to doubt. Among these results are the non-linear additional terms to the Maxwell equations derived by Euler and Kockel[2]. They describe the behaviour of an electromagnetic field containing only frequencies $\nu \ll mc^2/h$. They may be expressed by an addition to the Lagrangian $L$ which for small field-strengths has the form:

$$L = \frac{1}{8\pi}(E^2 - B^2) + \frac{e^4 h}{m^4 c^7}\left[\alpha(E^2 - B^2)^2 + \beta(EB)^2\right] \quad \ldots \text{ i}$$

$E$ being the electric, $B$ the magnetic field strength. This follows directly from relativistic invariance, leaving only the values of the constants $\alpha$ and $\beta$ undetermined. With the convention mentioned above, these are found to be $\alpha = 1/360\pi^2, \beta = 7/360\pi^2$.

We have succeeded in deriving the constants $\alpha$ and $\beta$ without making use of the subtraction convention of Dirac and Heisenberg. As mentioned above, the scattering of light by electrostatic fields can be calculated without having to deal with divergent expressions. We have done this for fields satisfying the condition

$$|\text{grad } E| \ll |E|\frac{mc}{h}.$$

The cross-section for light with frequencies $h\nu \ll mc^2$ is of the order of magnitude:

$$g \sim \left(\frac{e^2}{mc^2}\right)^2 \left(\frac{e^2}{hc}\right)^2 \left(\frac{h\nu}{mc^2}\right)^4 \frac{W}{mc^2},$$

where $W$ is the total energy of the scattering field. The exact expression depends on the angles between the light vectors and the scattering electric field. As this scattering process can be considered as a consequence of non-linear field equations, it can also be calculated by means of the Lagrangian (1).

By comparing the former result with the expression derived from the Lagrangian, the constants $\alpha$ and $\beta$ are completely determined and one gets the same values as derived with Heisenberg's convention. Thus all the results following from the non-linearity of Maxwell equations, for example, the cross-section for scattering of light by light as found by Euler and Kockel, seem to be of the same trustworthiness as the cross-section for pair production derived by Bethe and Heitler.

The extension of this calculation to the scattering by the nuclear Coulomb field is in progress.

N. KEMMER.
V. WEISSKOPF.

Physical Institutes of the University
and the Eidg. Technische Hochschule,
Zurich.
Feb. 12.

[1] P. A. M. Dirac, *Proc. Camb. Phil. Soc.*, 30, 150 (1934). W. Heisenberg, *Z. Phys.*, 90, 209 (1934).
[2] H. Euler and B. Kockel, *Naturwiss.*, 23, 246 (1935).

## Pre-Gibbs Adsorption by Surface Rearrangement

IT has been an unresolved paradox[1] that for many solutions such as soap the surface tension is only a fraction of that of water, and yet the Gibbs theorem strictly requires that in the neighbourhood of the surface there should be proportionately more water than in the bulk of the solution. When the solution is thoroughly mixed and uniform right up to the surface (dynamic surface tension), the surface tension is practically the same as that of water. After a few thousandths of a second, the surface tension is very greatly lowered, in spite of the accumulation of more water in the surface demanded by Gibbs.

It may therefore be suggested that the surface tension is lowered, not merely by orientation of dissolved molecules which originally chanced to be exposed on the surface, but also that there is an interchange of positions between molecules of solute and solvent within a few molecular diameters of the surface. Thus a solution might almost immediately be partially covered by a layer of solute exposing only hydrocarbon groups and overlying another layer that would be mainly water. Complete coverage could lower the surface tension by more than 30 dynes, as shown by the Pockels-Langmuir-Adam trough with oleic acid on pure water. This would also account for the observation that oleic acid will not spread on the surface of a soap solution, although it does so immediately upon water and upon solutions of most substances.

The conception of pre-Gibbs adsorption by surface rearrangement arises primarily from a series of studies by my collaborators, Drs. T. F. Ford, D. A. Wilson and Mr. G. F. Mills, using solutions of substances such as phenol, caprylic acid, and especially hydrocinnamic acid.

The surface tension of a solution of the latter containing 1·5 gm. per litre is almost instantaneously lowered by at least 10 dynes, but the microtome method shows that the Gibbs adsorption is negligible, the average composition of the surface sandwich layers being still that of the whole solution. The Gibbs adsorption requires many (12) hours to rise to its approximately complete value. Again, an insoluble substance spreads on these freshly swept solutions almost as freely as on water; whereas, after Gibbs' adsorption occurs, spreading is slow and difficult. Further evidence is obtained from the surface tension of freshly swept surfaces and of samples from the same container poured from underneath the surface, from a surface that has been allowed to stand, and from a frothed surface. Our conception, together with the observation that the Gibbs layer is relatively slowly soluble, would explain the fact that a moving bubble may yield reproducible values for adsorption which range from many times smaller to many times larger than Gibbs.

JAMES W. MCBAIN.

Stanford University,
California.

[1] J. W. McBain and D. A. Wilson, *J. Amer. Chem. Soc.*, 58, 379 (1936).

## Adsorption of Nitrogen on Tungsten

IN a recent paper[1], it has been shown that it is possible to study the adsorption of hydrogen and oxygen on a tungsten wire and to measure the heat evolved and the amount of gas adsorbed. Experiments have now been carried out with similar apparatus using nitrogen, and they have shown that, if less

nitrogen than is sufficient to cover the bare wire is admitted, the whole of this nitrogen is rapidly adsorbed on the wire, that is, the residual pressure is negligible. The behaviour of nitrogen is thus similar to that of hydrogen. The adsorption of the whole charge shows definitely that the effects observed cannot be due to impurities of, for example, oxygen in the nitrogen. The experiments were carried out at room temperature.

In previous work on the adsorption of nitrogen on tungsten, no evidence for this type of adsorption has been found, but, as in the case of hydrogen, only a slow (activated) adsorption. In view of the present results, this failure must be taken as being due to the presence of adsorbed films of impurities on the tungsten. The thermionic method has also failed to detect the adsorption of nitrogen[2] on tungsten, presumably owing to the high temperatures necessary to obtain appreciable emission.

The properties of the nitrogen film are being studied in detail and the results will be published in due course.

J. K. ROBERTS.

Department of Colloid Science,
University of Cambridge.
March 21.

[1] Roberts, *Proc. Roy. Soc.*, A, **152**, 445 (1935).
[2] Langmuir, *Phys. Rev.*, **37**, 1006 (1931).

## Preparation of Stereoscopic Red-Green Wall-Diagrams

I SUPPOSE that, during the course of teaching most science subjects, there are occasions when students would be able to visualise more quickly what the lecturer is trying to describe if they could be shown the object in three dimensions. Wall-diagrams of the stereogram type and models are all right as far as they go, but they cannot show the relations of internal structures as well as they would if they were stereoscopic and completely transparent. So far as I know, the use of stereoscopic red-green wall-diagrams is rarely resorted to, yet they are extremely efficient and, within limits, are not difficult to produce. The details of the method I have found satisfactory are these:

First of all the necessary plans and elevations are prepared to some definite scale and from these a perspective drawing is made. The angle of view chosen depends, of course, upon the shape of the object but as, for purposes of accuracy, the larger the drawing is the better, and as an exaggerated perspective is to be avoided, the principal vanishing points should not be more than about 40° and 50° to the principal visual ray. As two drawings have to be made with the same vanishing and measuring points, the most convenient method is to have a sheet of paper filling the board and marked with the horizon line, ground line, principal visual ray, and vanishing and measuring points. On this is fixed, over the appropriate area, a smaller sheet of paper upon which the parts of the above lines and those points within its area are traced. The first drawing, marked 'left', is then made (Fig. 1) and finished off in Indian ink or process black. The horizon line must also be inked.

The greater dimension of the drawing is then measured and the magnification, to enlarge it to fill adequately the sheet to be used in making the wall-diagram, estimated. Two and a half inches (the normal inter-pupillary distance) is then divided by this magnification factor and the dividend is the actual distance which the nearest point of the object must be moved to the left in making the second drawing. (It simplifies the technique a little if this point is on the picture plane.) It does not matter if, for the sake of getting a convenient length to measure, rather more than 2·5 in. is taken: up to a point such an alteration will only enhance the stereoscopic effect.

The first small sheet is removed and the second drawing is made on another one with the nearest point of the object in its new place, inked in and marked 'right'. These two drawings are then successively photographed and their negatives projected on to the diagram sheet, care being taken not to make any camera or projector adjustments between the exposures and to use sufficiently good lenses to avoid spherical aberration. There will be a difference in the actual width of the two drawings, but any modification thus introduced in the final magnification is immaterial. These photographic and projection stages have to be introduced into the process as the making of a perspective drawing of adequate size by the direct method is impracticable.

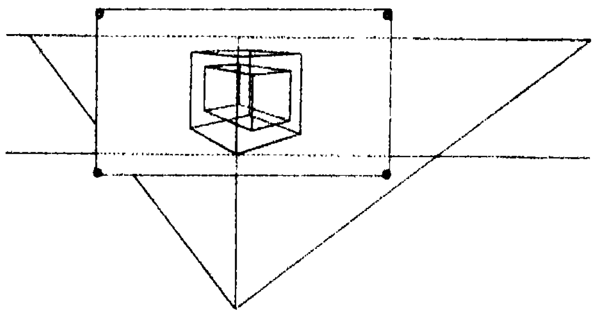


FIG. 1. The first drawing on its sheet, which has been pinned over the appropriate area of the large sheet.

If the left eye of the spectacles to be used is red, the bright lines of the left negative are lightly registered on the paper with a green pencil. The horizon line is also marked, but only at the edge. The right negative is then substituted, its horizon line adjusted to that marked on the sheet and the position of the nearest point of the object decided upon. If it is placed upon the same spot as that of the first drawing, the object will appear just behind the paper. If, however, it is placed 2·5 in. to the left, the object, a perfect ghost, will appear half-way between the observer and the paper. This can be helpful to the student as, standing 8–10 ft. away from the diagram, he can with a pointer actually follow the solid shape and is only worried because the pointer has the curious habit of hiding edges behind which it obviously lies! A greater divergence than 2·5 in. should not be employed owing to the difficulty of dissociating eye-accommodation from eye-convergence, which is introduced. For ordinary use in the lecture theatre, a diagram with the nearest points of the two drawings coincident is perhaps the most satisfactory as the object then appears full size.

After the second negative has been registered with a red pencil, the diagram is inked, using very broad nibs, such as Mitchell's Pedigree Round-Hand No. 1. The inks I have used have been made from Pinatype

Complementary Red and Green D, but they and their dilution depend upon the paper and the spectacles being used. The kind of spectacles we have are of cardboard with celluloid eyes costing four shillings a dozen, so the outlay even for a large class is not serious. Having found the right strength of ink, use the green first, as the red has a tendency to run along the wet green lines if they are used in the reverse order.

It improves the general appearance and ease of interpretation of the diagrams if the near edges are made at least twice as wide as those at the back (the others very roughly in proportion) and if the parts needing special emphasis are cross-hatched. By the latter means parts are given a solidity which, however, is translucent and so the relation of internal structures to the parts in front and behind them is easily appreciated.

These wall-diagrams are perfectly satisfactory even when viewed from a fair distance or from the side. Their only disadvantage compared with the ordinary kind is that the lecturer cannot successfully *point* to any part (except the nearest point when they are drawn coincident) as the apparent position varies with the view-point. This, however, is more than compensated for by the ease with which the shape is seen and can be described and, anyhow, the parts can easily be lettered.

To anyone familiar with perspective drawing technique the production of these wall-diagrams is not difficult unless there are many curved surfaces to be represented. These can only be reproduced by drawing their lines of curvature, the projection of which is a laborious task. In many instances, however, such a task can be avoided by substituting polyhedral surfaces for the curved ones. I have, for example, made a pair of diagrams to show the invagination of the optic vesicle to explain the reason for the appearance of the choroid fissure, the relation of the retinal and pigment layers, etc., with this modification, and it is quite satisfactory.

In the above account I hope I have omitted no important detail of the method, but, if any reader has any question to ask, I shall be happy to try to answer it.

G. L. PURSER.

University,
Aberdeen.

## Shadows of the Retinal Blood-Vessels seen by Monochromatic Light

IT is well known that the shadows of the retinal blood-vessels may be seen if a pinhole is held in front of the eyes near to the anterior focus and moved from side to side. They are also sometimes seen in a microscope field, though they disappear if the eye is held still and comfortably adapted. During some observations with a monochromator, I noticed that the patterns could easily be seen in the field when blue light was used, but that they could not be seen at all with green light. Further experiments, with about ten observers, showed that most people could see the patterns easily with light of $\lambda$ 4078 and $\lambda$ 4358 (violet and blue), much less easily with light of $\lambda$ 4916 (blue-green) and not at all in the range $\lambda$ 5000–$\lambda$ 6000 (green and yellow). They could be seen again in the red, but not nearly so easily as in the blue and violet. By removing the prism and substituting a plane mirror, so as to retain the same geometrical arrangement, I found that they could be seen with white light. Dilution of the blue with a little green made the patterns much less clear.

On examining the pinhole effect with monochromatic light, I found that the patterns could be seen by any colour if the pinhole was moved rapidly, but only by blue light if it was moved very slowly. The effect depends on so many factors that it is not possible to give any quantitative data, but the minimum speed for green appeared to be about five times as great as that for blue light. The patterns were more easily seen with strong light than with weak, up to the limit of comfortable illumination.

It is usual to explain the fact that these patterns are not seen in ordinary vision by assuming that the eye has some compensatory mechanism for ignoring them. Thus the receptors on which the shadows normally fall may become hypersensitive, so that they give a full response when stimulated by the small amount of light passing through the vessels. They are seen in the pinhole experiment because the retina is illuminated by fairly narrow pencils of light. When the pinhole is moved, the direction of illumination changes and the shadow moves from one set of receptors to another so rapidly that the compensation is defeated. In the microscope field the effect is produced by flickering of the eye when it is not comfortably adapted. In seeking to apply this explanation to the experiments with monochromatic light, we may note that the effect is supposed to depend on the rate at which the adaptation is able to take place. Our results could be explained if either, (*a*) for blue light a given movement of the pinhole produces a greater movement of the shadows than for other parts of the spectrum, or (*b*) for blue light the adaptation is more rapid. At first sight, supposition (*a*) appeared very attractive. If the reception action takes place mainly as the light is absorbed in the visual purple, we should expect that the reception of the blue and red would take place mainly at a greater depth than reception of the blue and green (owing to the strong absorption in the green). This would mean that for a given change in the direction of illumination the shadows would move farther for blue than for green. This explanation had to be abandoned because direct experiments show that there is no difference in the depth of the different receptors[1]. On the other hand, if explanation (*b*) is correct, we should expect to find effects of a corresponding nature in experiments on fatigue. I can find no evidence of such results, though there is no definite negative evidence.

According to Roaf's theory of colour-vision, blue light stimulates the rods rather than the cones, and this might suggest a reason for a different rate of adaptation to changing illumination. It would not explain the difference between red and green found in the experiments with the monochromator. This difference, which was small, may have been due to some subsidiary effect, especially since it could not be found in the pinhole experiment.

R. W. DITCHBURN.

Trinity College,
Dublin.

March 10.

[1] Koster, *Archiv Opthalmologie*, 41, 1. In view of the fact that Koster's results were in conflict with earlier work, I have repeated some of his observations and confirmed his conclusions.

## Recent Research on Cancer

IN his reply in NATURE of February 22 to our criticism, Mr. Lockhart-Mummery has set out what he considers are the "exact facts". In fairness to my co-workers and myself, I must point out that the exact facts are as follows:

The actual statement made by myself in my annual report reads: "While our experiments are as yet unfinished we feel we are on safe ground when we say (1) that given a full mixed diet, infestation with the parasite *Gongylonema neoplasticum* induces no changes other than perhaps an occasional trivial hyperkeratosis of the squamous epithelium—certainly there is no papillomatosis and nothing resembling malignant disease: (2) that, given a diet deficiency of the natures stated, the parasite appears to induce some hyperplasia and papillomatosis but again nothing resembling frank malignant disease." Mr. Lockhart-Mummery's paraphrase in his editorial reads: "While no difficulty was found in establishing the presence of the parasite in the œsophagus and stomach of the rats, and in parts of the pharyngeal tract, the experiments have been almost entirely unsuccessful in producing cancer. Since no doubt exists that it was Fibiger's parasite which was employed, the experiments appear to show that, provided the rats are fed on a correct diet, cancer does not develop as a result of this parasitic infection." Thus Mr. Lockhart-Mummery paraphrases part (1) of my sentence only and makes no mention of the highly relevant part (2). If it had been included, it is obvious that there would have been no grounds on which the writer of the article in NATURE, or anyone else, could reasonably have made the statement to which we originally took exception.

Again, in his comment in NATURE of February 22, Mr. Lockhart-Mummery purports to quote me verbatim. It will be seen, however, that he omits the whole of part (2) of my sentence. The omission of part (2) of my sentence makes the quotation incomplete, while the omission of "(1)" conceals the fact that only part of my sentence was quoted.

The inclusion of the word 'almost' in Mr. Lockhart-Mummery's editorial is quite inaccurate in a scientific report. We were *entirely* unsuccessful in producing cancer; my annual report made this quite clear.

R. D. PASSEY.

Department of Experimental Pathology
and Cancer Research,
School of Medicine,
Leeds, 2.
March 26.

## Chromosomal Relationship between Males and Females in Hymenoptera Symphyta

A RECENT cytological investigation by me of chromosome individuality in three arrhenotokously parthenogenetic species of Hymenoptera Symphyta has yielded evidence which indicates that the relationship between the females and males is not one of diploidy : haploidy, but is of tetraploidy : diploidy. This concept leaves considerably less to be explained with regard to the occurrence of parthenogenesis; but the matter of the abortive meiosis in the spermatogenesis of impaternate males would seem, at first sight, to be elevated thereby to the rank of a first-rate problem. Resolution of this, however, is still possible along cytogenetic lines on the basis of a principle of gene-controlled meiosis.

Extended application of the idea renders intelligible the phenomena of 'pre-conjugation' observed during maturation of the gametes in the bee, as demonstrated by Nachtsheim[1], and in *Cynips kollari*, as found by Hogben[2], as the occurrence in a derived tetraploid of a more or less vestigial synapsis interfering with functional synapsis.

Still more recent work on certain arrhenotokous Tenthredinidæ reveals leptotene and syndesis during prophase of the abortive division. It cannot, however, at present be stated whether the threads entering the syndetic knot are of a dual nature and synaptically paired.

The significance of the observations may be that the appearances represent true synapsis in an organism hitherto regarded as haploid and really diploid, or that they are of stages through which chromosomes pass, at this stage of gametogenesis, irrespective of whether homologous mates are present or not. In the former case emphasis would be placed on failure of the spindle mechanism, known to occur, in securing non-reduction.

FRANK GREENSHIELDS.

4 Airlie Terrace,
Dundee.
March 10.

[1] Nachtsheim, *Archiv Zellforsch.*, 11 (1913).
[2] Hogben, *Proc. Roy. Soc.*, B, 91 (1920).

## Accommodation Coefficient of Deuterium

IN attempting to find the relative times of life of hydrogen and deuterium molecules on a bare platinum surface, preliminary results have been obtained for the accommodation coefficients of hydrogen, deuterium and helium relative to a normal (that is, unflashed) platinum wire, the wire having been annealed at red heat in air for about one minute to remove strain.

The publication of these results may be of interest on account of their applicability, at least in so far as relative magnitudes are concerned, to determinations, by methods of thermal conduction at low pressures, of deuterium concentrations in hydrogen.

With the wire at a mean temperature of 100·7° C. and the surrounding gas at temperatures of about 16° C., the accommodation coefficients of hydrogen, deuterium (99·2 per cent) and helium were found to be $0{\cdot}24_3$, $0{\cdot}30_4$ and $0{\cdot}29_4$ respectively.

In calculating the value of the accommodation coefficient, the ratio of the specific heats of deuterium in this temperature range has been assumed equal to that of hydrogen. The deuterium used was the product of the total decomposition by sodium of heavy water of guaranteed 99·2 per cent content of deuterium oxide. While the actual proportions of $D_2$, HD and $H_2$ molecules are not known, the percentage of these two latter is not sufficient to affect the result obtained for deuterium.

W. B. MANN.
W. C. NEWELL.

Imperial College of Science,
London, S.W.7.
March 21.

## A Simple Method for Testing Homogeneity of Wood

SOME time ago[1] we found that there seems to be a characteristic difference in the structure of the wood used for the building of string instruments: X-ray investigations have shown that the top always exhibits a very marked fibre structure, whereas the back in instruments of good tone quality is nearly homogeneous.

The question arises whether it is possible to find these differences by methods which might have been available to the Italian makers of the classical period? I found that it is possible to obtain this information by using heat conductivity in the different directions of the wood as an indicator of its homogeneity. It is well known that a thin layer of wax applied to a crystal face will melt into a figure of definite contour (isotherm) if the crystal is touched at one point with a hot wire. The same method can be easily applied to wood, and one finds that the isotherm on a piece of wood cut vertical to the fibre is always a circle, except where a knot produces an inhomogeneous region. The isotherm on a cut parallel to the grain varies in its outline for different materials. The ratio of the axes for pine used for the top of violins has been found as high as 1·95, and for nearly homogeneous maple used for the back 1·15. We have obtained recently, through the courtesy of Dr. A. Koehler, director of the U.S.A. Forest Products Laboratory, Wisconsin, some samples of white ash which range, as revealed by X-ray investigations, from very marked fibre structure to almost complete homogeneity. The same variation and exactly the same order has been found by using the isotherm method.

It is possible that such a method, discovered accidentally, may have been used by the instrument makers, since many of the old instruments exhibit branding marks even if the maker did not use a brand for the identification of his instruments.

K. LARK-HOROVITZ.

Physical Laboratory,
Purdue University,
Lafayette, Indiana.
Feb. 17.

[1] NATURE, 134, 23 (1934).

## The Structure of Light Waves

I WAS very much interested in Sir J. J. Thomson's letter[1] in which he suggests that light waves are axially symmetrical systems of electro-magnetic waves propagating *along* the axis of symmetry, as I made the same suggestion in 1929[2] and then repeated it in my recent papers in the *Philosophical Magazine*[3] where this kind of Maxwell waves was discussed in detail; on the basis of this discussion a theory of elementary "material" particles (like electrons and protons) and of the photons was developed, according to which these entities were regarded as certain axially symmetrical systems of Maxwell electro-magnetic waves.

Similarly to Sir J. J. Thomson, I used the Maxwell equations in *cylindrical* co-ordinates, and I have transformed these equations practically into the same form as Sir J. J. Thomson does[4], only a little more generally, and correspondingly obtained a solution[5] of which Sir J. J. Thomson's solution $Q = A\rho + B/\rho$ represents a particular case[6].

This particular case is, however, *unsuitable* for *free* electromagnetic waves, for $Q$ becomes infinity, either at $\rho = 0$ or $\rho = \infty$, or both. Sir J. J. Thomson tries to avoid this by putting $A = 0$ when $\rho > a$, and $B = 0$ when $\rho < a$. But then we shall obviously obtain not *free* electromagnetic waves, but electromagnetic waves propagating along a cylinder of radius $a$, co-axial with the axis of symmetry of the waves, made either of conductive material with infinite conductivity or an insulator with infinite dielectric constant (when the magnetic lines of force are circular while the electric lines of force are situated in axial planes) or alternatively, of ferro-magnetic material of infinite permeability (when the electric and magnetic lines of force are situated vice versa)[7]. Otherwise the Maxwell equations would be no longer valid at the surface of this cylinder, owing to the discontinuity of the axial component of the vector situated in axial planes and, as is not difficult to find, proportional to $A$.

For this reason I have not considered in detail the particular case which was used by Sir J. J. Thomson, but discussed a more general solution in which the *phase along the radius was variable*[8].

However, later I found that even this more general solution was not satisfactory for various reasons, and, therefore, I based my further discussion on solutions in the form of Bessel functions, in which no such discontinuity exists[9]. This discussion led eventually to the above-mentioned theory of elementary particles, including photons, which explained their fundamental properties, classical as well as wave mechanical and relativistic, and also the actual numerical value of the mass ratio between the proton and the electron, on the basis of Maxwell electrodynamics.

In conclusion, I would like to express the hope that Sir J. J. Thomson's letter will increase the interest in the axially symmetrical electromagnetic waves, for I am convinced that this study must contribute essentially to the solution of various problems of physics. The fact that Sir J. J. Thomson arrived at the conclusion as to the importance of this kind of waves without being aware of my previous results makes his opinion still more valuable as a stimulus. The value of this stimulus is not affected by the unsuitability for the free electromagnetic waves (and hence for light waves) of the particular solution which Sir J. J. Thomson tries to apply.

N. S. JAPOLSKY.

Davy Faraday Laboratory,
Royal Institution,
Albemarle Street,
London, W.1.
Feb. 10.

[1] NATURE, 137, 232 (Feb. 8, 1936).

[2] *Z. Phys.*, 54, 1 and 2, 121 (1929).

[3] *Phil. Mag.*, 19, 954 (1935); *ibid.*, 20, 441, 646, 695 and 702.

[4] See equation (24) in *Z. Phys.*, *loc. cit.*, from which Sir J. J. Thomson's equation $\frac{d}{d\varrho}\left(\frac{1}{\varrho}(\varrho Q)\right) = 0$ is obtained as a particular case by equating the constants $l = 1$ and $k = 0$.

[5] See formula (27) in *Z. Phys.*, *loc. cit.*, Sir J. J. Thomson's solution is obtained as a particular case by putting $l = 1$ and $k = 0$.

[6] The notation used in my paper differs from the notation in Sir J. J. Thomson's letter. His $Q$, $\varrho$, $A$ and $B$ correspond to my $Y$, $r$, $\sqrt{C_1}$ and $C_2\sqrt{C_1}$ respectively.

[7] The solution suitable for *free* axially symmetrical waves of this kind requires that the radial component of the electro-magnetic vector at $\varrho = 0$ should not only be finite, but also equal to zero (see *Z. Phys.*, *loc. cit.*, 116).

[8] *Z. Phys.*, *loc. cit.*

[9] *Phil. Mag.*, *loc. cit.*

### The Solar System and its Origin

IN Prof. H. N. Russell's recent book of the above title, the belief is expressed that the assumption of the sun having been originally one component of a binary star would help to resolve certain difficulties. To get rid of the other member an almost central collision with another star is invoked, but I have shown that a close encounter of the sun's companion with another star may disrupt the system, both stars escaping from the sun.

If we assume that during such an encounter a filament of material is ejected between the two stars, then it is natural to suppose that the velocities of the various portions of this filament relative to the sun will be distributed more or less uniformly between the velocities of the two escaping stars. Under a wide variety of conditions of encounter, a reasonable proportion of the filament may be left with velocities less than that of escape from the sun, and in this way the primitive planets formed. Further, it can be shown with no severe restriction on the encounter that the angular momentum per unit mass may have been in the same general direction round the sun, though very different in amount for the various condensations in the filament.

These primitive planets, having all been produced in a comparatively small region, will return to somewhere near the region, and accordingly there is an opportunity for the subsequent production of satellites by close encounters between the planets themselves. In this connexion, it is interesting to note that the moon could have been produced by an encounter of the earth with Venus.

RAYMOND A. LYTTLETON.

Princeton University Observatory.

March 3.

## Points from Foregoing Letters

DR. R. J. TILLYARD gives a drawing of the veins of the wings of a recently found fossil cockroach of Lower Permian age and compares it with that of the present day giant Australian termite *Mastotermes*, which represents the most archaic type of that order. The close correspondence in the vein arrangements indicates that termites and cockroaches have a common ancestor, and that while the wings of the cockroaches have developed, those of termites have been in part eliminated.

Preliminary results obtained by Dr. E. Bäcklin and H. Flemberg with an improved apparatus for determining the charge of an electron by means of the oil-drop method give a value of $4 \cdot 800 \times 10^{-10}$ abs. E.S.U., which is in closer agreement with the value obtained from X-ray spectrographic data than the previously accepted value ($4 \cdot 752 \times 10^{-10}$).

F. C. Frank discusses the question whether the value for the electronic charge obtained from X-ray measurements on calcite may not be vitiated by imperfections in those crystals. From the work of Joffé on electrical conduction in calcite, he infers that imperfections (unfilled lattice spaces) exist; this would apparently increase the value of the electronic charge by about 1 part in 5,000.

In recording X-ray diffraction by gases, one may replace the photographic plate by a Geiger-Müller counter (for counting ionising particles), according to W. van der Grinten and Dr. H. Brasseur. The authors submit a curve of intensities obtained by passing X-rays through carbon tetrachloride gas, and deduce a value for the distance between chlorine atoms in good agreement with that previously known.

By seeding a brass alloy containing 52 per cent copper in process of solidification with copper crystals, and analysing with X-rays the orientation of the resulting crystals, A. B. Greninger finds a sequence of crystallisation from bottom to top: (1) copper crystal seed, (2) primary crystallised $\alpha$-phase having the same orientation as the copper seed, (3) large $\beta$-grains having a narrow rim of segregated $\alpha$-phase.

By means of apparatus which enabled them to sort out the atoms of positive from those of negative overall moment (of the same magnitude), J. M. B. Kellogg, Prof. I. I. Rabi and J. R. Zacharias find that the magnetic moment of both the proton and deuteron are positive.

DR. L. Infeld states that it is possible to formulate a simple unitarian field theory which, when used in the formula for the scattering of light by light derived by Euler and Kockel, enables the approximate determination of the fine structure constant.

Drs. N. Kemmer and V. Weisskopf have derived the deviations from the Maxwell equations caused by the existence of the positron in a manner free from the ambiguities formerly attached to this calculation.

The surface tension of certain soap solutions passes through a minimum and rises again with increasing concentration, while still remaining considerably below the surface tension of water. Gibbs's theory would then require that there should be more water and less soap in the surface layer than in the interior of the solution, which is not the case. Prof. J. W. McBain considers that the possible existence of another preliminary factor contributing to the lowering of surface tension, namely, the interchanging of positions between molecules of solute and solvent within a few molecular diameters of the surface, may explain the apparent paradox.

It has long been known that, under suitable conditions of illumination, the shadows of the retinal blood-vessels can be seen. Prof. R. W. Ditchburn has examined this effect with monochromatic light and finds that the shadows are much more easily seen with blue light than with green. Reasons for this difference are suggested.

F. Greenshields reports that in certain insects which lay eggs without fertilisation, the cells contain twice the basic number of chromosomes in the male (diploidy) and four times the number in the female (tetraploidy). This observation makes it necessary to find a new explanation for the sterility of the fatherless male offspring. It throws some light, on the other hand, on the 'pre-conjugation' observed during the maturation of the reproductive cells in the bee and gall-wasp.

A simple method of testing the homogeneity of wood, which may have been employed by famous makers of string instruments in the past, is described by Dr. K. Lark-Horovitz, It depends upon observing the heat conductivity of wood in different directions, by covering it with a thin layer of wax and noting the shape of the molten figure when a hot wire is applied to it at a given point.

# Research Items

### Racial Crosses in South Africa

IN a study of racial problems in South Africa, which appears in the *Scientific Monthly* of February, Prof. H. B. Fantham, formerly of the University of the Witwatersrand, Johannesburg, records a number of observations of the results of crossing between the various racial groups in the population of the Union. Details are given of fourteen Eur-African crosses, ten Afro-Asian crosses and two Eurasian. Some of the Afro-Asiatic cases have European blood on the African side. There are also native hybrids, the ethnic melting-pot areas being the Kalahari (Bushman-Hottentot-Herrero-Bechuana), the junction of the Vaal and Orange Rivers (Bushman-Koranna-Hottentot-Bechuana) and the north-eastern Transvaal (BaPedi-BaThonga-BaVenda). While the predominant elements in the white population are English and Dutch, there are also survivals of Portuguese and Huguenots; and in recent times Germans and Jews, especially from Central Europe, have been added. There is also the Indian element and a remnant of Chinese labour. The 'Cape coloured', who are the result of Hottentot, Kafir and Malay admixture with Europeans since the days of early settlement, now equal in number one third of the white population. Some of the hybrid-coloured form distinct groups, such as the Griquas (Dutch-Hottentot-Bush) and the Rehoboth Bastards (Boer-Hottentot). A simple case of miscegenation, in which a fair-haired, blue-eyed Belgian married a Zulu woman, produced eight children, who classify themselves as black (2), white (2) and brown (4). In the first generation a 'black' woman married to a Zulu produced two black and two brown; a 'white' woman married to a Zulu produced one black and one white; while in the second generation a 'white' daughter who married her black cousin has a brown daughter. Of the fifteen descendants of the original couple, six approximate to the Zulu type (black), three to the European (white), and six are brown. Socially the brown are despised by black and white alike. As a result of the observations, the racial crosses are not to be commended. The coloured race has neither the energy nor the persistence of the white, is less stable temperamentally, and is not controlled by the tribal conventions of the native.

### Barndoor Fowl in Egyptian Art

MR. G. D. HORNBLOWER comments on the absence of the domestic fowl in ancient Egyptian art in describing a wooden spoon of unknown age and provenance, which he believes to be unique (*Ancient Egypt and the East*, **2**; 1935). It was bought from a dealer in Cairo some years ago. Its dimensions are: length, 8½ inches; length of bowl, 3¾ inches; breadth of bowl, 1¾ inches. The bowl is delicately carved in an oval, such as is found in known specimens of the New Kingdom. The present example is remarkable in that it has a barndoor fowl carved at each end of the handle. The identity is clearly shown by the carriage and upright port of the tail, which differs from the drooping tail of the wild jungle fowl. The bird which usually decorates the finials of a spoon is the duck. The barndoor fowl, of which the representation here appears to be unique, was not introduced into Egypt until the eighteenth dynasty, if not later. This late entry accounts for its absence in the history of art in the country. The conventions for pictures of ordinary life were fixed under the Old Kingdom, and were strictly maintained for later periods by religious conservatism. Therefore, although in Babylon the domesticated jungle fowl has some religious significance, in Egypt it was not admitted as a decorative element in art, unlike the duck and goose, which figure largely in the revered works of the Old Kingdom, and accordingly were admitted freely into later art.

### Mortality Rates for England and Wales

A NEW estimate of expectancy of life at various ages is given in the tables published in the Registrar-General's Decennial Supplement, England and Wales, 1931 (London: H.M. Stationery Office). Mortality rates show a great improvement in vitality at all but the most advanced ages. The improvement is most marked at the youngest ages. The probability that an infant will die within a year of birth has decreased between 1931 and 1911 by as much as forty per cent. On the other hand, at advanced ages the 1931 mortality rates are rather heavier than those of 1921 or 1911. The deterioration is compared with the 1921 rates; it first becomes apparent at sixty-nine years of age in males and at seventy-eight in females. This is attributed partly to the survival in the present generation of many of the weaker members of the community, who under former conditions would have succumbed before old age was in sight. The geographical distribution of mortality is of interest. It is heaviest among both sexes in the north of England, and becomes lighter towards the south. In county boroughs, that is, urban areas, mortality is usually heaviest for both sexes, and in rural districts where mortality is lightest the male rate is much lower in relation to the general average than the female. Detailed tables for Greater London show that the male death rates in that area are lighter than for the average of England and Wales up to forty-five years of age, and the female rate is lighter at all ages. However, the outer ring or London suburban area shows a lighter death rate for both sexes than the country as a whole, and lighter than the rates for other urban areas.

### Munida from the Falkland Islands

MR. G. W. RAYNER makes some very interesting observations on the two closely related species of *Munida*, *M. subrugosa* and *M. gregaria* (Discovery Reports, **10**, 209–245; 1935). These two crustaceans are of much importance as food, especially for the whalebone whales, but also for the southern sea lions, fishes and sea-birds, the free-swimming post-larva of *M. gregaria* (the so-called "Grimothea") being met with in large swarms, sometimes covering an area of four miles in length. The larval stages are described, but the two species are much alike and have not been differentiated until the post-larval stage is reached. They are like *Galathea* in many ways and seem to link this genus with the larval species of *Munida* so

far known. The material available is large, especially of *M. subrugosa*, enabling the growth and distribution, as well as probable breeding seasons, of both species to be worked out. The gradual development of the male and female pleopods is described and figured in detail. Several parasites and epizoa are recorded. *M. subrugosa* is apparently more numerous in these regions, but not found in any numbers below 200 m.; both species occur near the coast, *M. gregaria* being remarkable for its neritic distribution and for the swarming habits of the post-larvæ, which have long been known. None of these peculiar swarms occurs far from land. They may be so dense as to give the water a reddish tinge, each swarm being spherical and from one to four feet in diameter, the patches looking like swarms of bees, with the individuals incessantly in motion.

### Gastropods from the Dutch East Indies

THE larger marine gastropods from warm waters are well known, and there are no new species in the splendid collection of Mitridæ and Terebridæ now described by Dr. Dautzenberg (Gastéropodes Marins. 1.—Famille Terebridæ. 2.—Famille Mitridæ. Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique. Mémoire du Musée Royal d'Histoire Naturelle de Belgique. Hors Série. Vol. 2, Fascicule 17, 1935.) Numerous striking forms familiar to conchologists are recorded, most of which have a wide distribution. The synonymy lists of some of them are enormous, sometimes filling two or three pages—in the case of *Mitra episcopalis* and *Terebra crenulatus* and *maculata* they occupy more than four each. Only the shells are described. The collecting grounds in these regions must be exceedingly prolific, judging from the present monograph consisting of 208 pages and illustrated by beautifully coloured plates. Besides the better-known and larger forms there are several small species of *Mitra* and allied genera, and here there are several new varieties and new names, whilst there are a few new varieties and new names among the species of *Terebra*.

### Marine Fishes of Nova Scotia

Two descriptive accounts of the marine fishes of regions not adequately dealt with hitherto have recently been published. In a paper on "The Marine Fishes of Nova Scotia" (*Proc. Nova Scotian Inst. Sci.*, **19**, Pt. 1, December 1935), by Vladykov and McKenzie, a complete review is given of all the marine and anadromous fishes (151 species) found around the Nova Scotian coast, with the exception of the Gulf of St. Lawrence. The area under survey lies roughly between latitudes 42° 15′ N. and 47° N., and between longitudes 57° W. and 66° 45′ W. It covers approximately fifty thousand square miles of coastal and 'bank' waters. A key, designed to assist the non-specialist in the identification of native fishes, is given, and 129 outline drawings accompany the descriptions.

### Soil Conditions and Lily Growth

THE Lily Conference of the Royal Horticultural Society held in 1933 raised some important questions as to the relation of certain lilies to the kind of soil in which they were grown. Dr. M. A. H. Tincker examined a large number of soil samples, showed that these plants were widely tolerant to acidity and lime content, and has more recently published the results of his experiments on drainage conditions ("Experiments with Lilies at Wisley", R.H.S. Lily Year Book, 1935, pp. 68–75). Lily bulbs planted in the resting condition are very susceptible to water-logging. This fact was established for several species by culture in pots, where the drainage could be controlled artificially, and by plantings at various levels upon the side of a ditch. It is an interesting point that two of the species tested, namely, *Lilium pardalinum* and *L. superbum*, are found naturally in semi-swamp conditions; but an examination of the published records indicates that the bulbs were always well above the water-table.

### Reserve Materials in the Felled Tree

AN interesting paper by S. E. Wilson on "The Fate of Reserve Materials in the Felled Tree" (*Forestry*, **9**, No. 2; 1935) is of interest since it would appear to afford some light on seasoning investigations. As is well known, forest trees are usually felled in the winter when the sap wood contains abundant reserve food materials. These, as starch, sugar, fat materials, etc., occur within the living storage cells. The fate of the reserve materials is now shown to depend on the treatment of the timber after felling. If the log is kept whole, and the bark retained to prevent rapid drying, the storage cells continue alive until all reserves are exhausted; whereas if the timber is converted quickly, and the cells killed by desiccation or kiln-heat, the reserve materials remain intact and cannot thereafter be removed by any known treatment. Timber containing reserve materials is shown to be a ready prey to wood-tunnelling beetles, for example, *Lyctus*, and sap-staining fungi. The author puts forward suggestions for the co-operation of forest botanists with timber technologists in order to extend the knowledge of these important reserve materials with the view of the better utilisation of British (and it may be added tropical) timber trees.

### Geology of Kap Dalton, Greenland

ONE of the three areas in Greenland where Tertiary sediments have been found is Kap Dalton in East Greenland. Here, well-preserved marine fossils and plant remains occur together, the age being probably Lower Eocene. During a second visit to the locality, a conglomerate consisting entirely of pebbles of igneous rocks—including highly alkaline types—was discovered at the base of the sediments by L. R. and H. G. Wager. In a report on the geology, L. R. Wager devotes special attention to these rocks, since they represent types not previously met with in the North Atlantic Tertiary Province (*Medd. om Grønland*, Bd. 105, No. 3; with coloured geological map and 6 plates of photomicrographs). The varieties described include malignite, monchiquite, kersantite, tinguaite, soda-trachyte, trachyandesite, trachybasalt, leucite-nephelinite and nepheline-leucitite. It is suggested that the pebbles are derived from a volcanic area, injected by hypabyssal and plutonic rocks, which once overlay the region about Davy Sound, and that the known alkaline intrusive rocks of Cape Parry, Cape Fletcher, Antarctic Harbour, etc., may be remnants of the same igneous field. The evidence available in 1918 suggested to Holmes that the later phases of igneous activity in the North Atlantic were the more alkaline; Wager now presents evidence that the earliest phases were also characterised by highly alkaline types. The petrological problem

offered by the area is like that of the Permo-Carboniferous association, in the Midland valley of Scotland, of vents of basic alkaline types with sills and dykes of quartz-dolerite.

### Geology of San Juan, Colorado

THIS region is one of unusual geological variety and interest, and the summary description now presented by Whitman Cross and E. S. Larsen (U.S. Geol. Surv. Bull. 843, 1935) will be widely welcomed as a preliminary to the more detailed studies now in preparation. A long succession of Pre-Cambrian events is displayed in the San Juan Mountains, including the formation of important series of injection complexes. At some time between the late Pre-Cambrian and late Jurassic a stock of alkaline rocks was intruded about Iron Hill. The oldest rock of this complex is a limestone, believed to be of hydrothermal origin. This was followed by uncompahgrite, a coarse-grained melilite-rock, which in turn was followed by a large mass of pyroxenite. There were intruded successively ijolite, nepheline-syenite, syenite, nepheline-gabbro, and finally quartz-gabbro. The increasing silicification of the rocks is notable. Beginning in the Miocene, the great accumulation of volcanic rocks that makes up most of the mountains was built up. These are mainly andesites, quartz-latites and rhyolites with associated breccias and tuffs; they include the extensive Potosi series of the Miocene and, after the reduction of the region to a fairly smooth surface (the San Juan peneplain), the almost equally extensive Hinsdale series of the Pliocene. In Quaternary time, after the earliest stage of glaciation (three stages have been recognised) local flows of andesite were erupted in the south-east. The region has been famous for its sources of gold and silver, with some lead, zinc and copper. The deposits occur mostly about intrusive bodies of Tertiary age or along faults in the volcanic rocks.

### Reception of Wireless Signals Underground

THE penetration of electric waves through the surface layers of the earth and the consequent possibilities of wireless reception underground are subjects of important scientific and technical interest. In a recent paper (*Hochfrequenztechnik und Elektroakustik*, **47**, 12; 1936), Dr. D. Doborzynski describes the results of an experimental contribution to this subject. Simple tests of broadcast reception on the medium-wave band (250–550 m.) were carried out in two caves at the village of Ojców, near Cracow, Poland. These caves are about 20 metres and 25 metres respectively below the ground and are situated in the limestone region of the Jura Mountains. The caves are very wet inside, and stalactite and stalagmite formations are present. The experiments were made in the evening in July and August, 1935; and, using an inverted L aerial, the successful reception of signals from various European broadcasting stations was obtained at distances ranging up to 1,000 km. Although no actual measurements were made, the signals, in general, appeared to be of the same intensity as those observed under similar conditions on the surface of the ground above the caves. In the case of the local broadcasting station at Cracow, 17 km. away, there was a noticeable reduction in the signal intensity in the caves over the values observed on the surface. This matter is to receive special attention in a more detailed investigation to be carried out in the future.

### Enzyme Action in Heavy Water

THE reports on the influence of heavy water on biological processes, including enzyme action, have been conflicting, and the data so far obtained for enzyme action are too meagre to be properly evaluated. Amylases catalyse hydrolytic reactions in which water is an important factor, and M. L. Caldwell, S. E. Doebbeling and S. H. Manian (*J. Amer. Chem. Soc.*, **58**, 84; 1936) have described experiments with preparations of pancreatic amylase of exceedingly high purity and activity. The heavy and ordinary water used were carefully purified and were shown to be free from oxidising substances (ozone and hydrogen peroxide). It was found that 100 per cent heavy water has no marked influence on the hydrolysis of starch by pancreatic amylase, provided the conditions of the experiments are such as to minimise the deterioration of the enzyme. The inactivation of pancreatic amylase, however, is more rapid and more pronounced when the amylase is held at 25° in highly purified heavy water than in similarly purified ordinary water.

### Approximate Heat Capacities of Gases

THE failure of the equation

$$C_p = a + bT + cT^2$$

to represent heat capacity data over large ranges of temperature has led to several other attempts to obtain a useful and sufficiently accurate formula. I. N. Godnev (*J. Amer. Chem. Soc.*, **58**, 180; 1936) shows that the equation

$$C_p = C_{p_s} + {}^{*}\Sigma\varphi(\theta_\kappa/T) + aT + bT^2$$

holds very satisfactorily if $C_p$ is the value calculated from spectroscopic data, and $\varphi(\theta_\kappa/T)$ is the Planck-Einstein function, tables of which are available. The equation was applied to carbon monoxide, nitrogen and sulphur ($S_2$) in the range 100°–5,000° K., in which interval it is allowable to put $b = 0$. The value of $\varphi$ is taken, in these cases, for two degrees of freedom. This equation is not at all cumbersome in use, and its extension to other gases would be interesting.

### Gasoline Efficiency

DR. M. R. FENSKE, of the Pennsylvania State College, recently reported to the American Chemical Society on the progress made by scientific workers in increasing gasoline efficiency. According to Science Service, of Washington, D.C., he emphasised the fact that efficiency of the modern gasoline engine depends on compression ratio. As this ratio is increased, 'knocking' appears, unless the octane number of the gasoline is correspondingly increased. Average automobile gasolines have an octane number of about 70 and gasolines of the ethyl type 78–80. Last year, however, chemists produced a gasoline having an octane rating of 92. One million gallons of this was ordered by the United States Government for use in army and navy aeroplanes. A similar quantity is to be delivered to the Government during the first six months of this year, and an intimation has been given that in future orders the octane number will again have to be increased. The primary cause for stress on gasoline efficiency is that the more miles of flight a gallon of fuel can produce the greater is the load the aeroplane can carry, and the longer its range of flight. These factors are of vital importance in the case both of commercial and bombing aeroplanes.

# Progressive Change in the Form of Growth Gradients

## GROWTH GRADIENTS IN THE ABDOMINAL LIMBS OF THE SHORE-CRAB

By Prof. J. S. Huxley

THE re-analysis of Shen's data (1935) on early post-larval development in *Carcinus mœnas* has proved interesting in showing a graded change with time in the shape of the growth gradients of the abdominal appendages. Dr. J. H. Day's work on the abdominal segments of the same species (see below) has led to similar conclusions. Since the phenomenon has not previously been recorded, at least in quantitative terms, it was felt advisable to publish simultaneous notes on the subject.

Each point in the graphs in Figs. 1 and 2 represents a single individual, so that the results cannot pretend to such accuracy as Day's. None the less, the general results are clear. Two main phases are involved: (1) a chiefly regressive phase, during which the large Megalopa limbs are converted into the post-larval type; (2) a progressive phase, during which those limbs represented in the adult show varying degrees of high positive heterogony. At the 5th or 6th instar, there is evidence of the onset of a third phase, of stabilisation (and we may presume that sexual maturity will introduce yet a fourth growth phase). Growth-coefficients ($k$) have been calculated according to the formula $y = bx^k$: carapace breadth has been used as standard ($x$). When, as during the regressive phase, a part diminishes in absolute size, the growth-coefficients have been given a negative sign: these cannot have the same biological significance as ordinary growth-coefficients, but serve to show the relative intensity of regression.

In males (Fig. 1) the regressive phase becomes more active in stage $B$ than at the metamorphosis ($A$), except that the first abdominal (first copulatory)

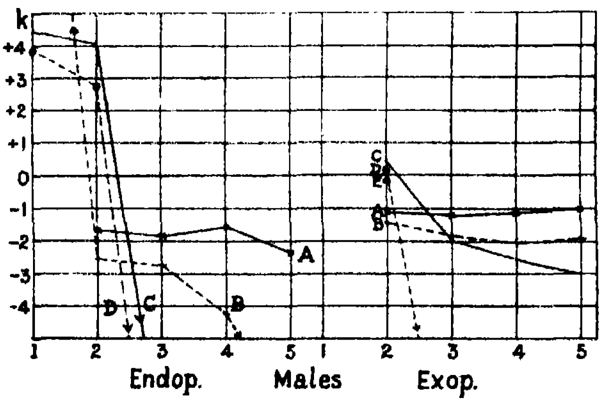



FIG. 1. Growth-gradients of endopodites and exopodites of the abdominal limbs of male *Carcinus mœnas* in successive stages. Ordinates, growth-coefficients ($k$); abscissæ, abdominal limbs. Stages: $A$, metamorphosis (megalopa to 1st young crab instar); $B$, 1st-2nd instar; $C$, 3rd-4th; $D$, 4th-5th; $E$ (shown for exopodites only), 5th-6th. Arrows indicate growth-coefficients of, or approximating to, infinity.

appendage, represented by endopodite only, first appears then. The second copulatory appendage does not begin positive growth until the next moult. The regressive gradient after stage $A$ has its high point posteriorly; the later positive gradient of appendages 1 and 2 has its high point anteriorly. The interaction of the two gradients is clearly shown, notably by the exopodites. These are all destined to disappear; but owing to the presence of the region of high growth in limbs 1 and 2, the regressive gradient in stage $C$ is tilted upwards anteriorly;

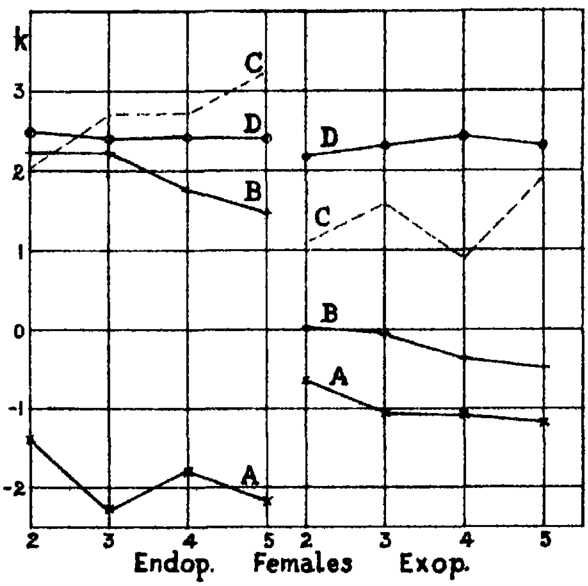



FIG. 2. Similar to Fig. 1, but for females. Stages: $A$, metamorphosis (as in male); $B$, 1st-3rd instar; $C$, 3rd-5th; $D$, 5th-7th.

exopodite 2 actually acquires positive growth-intensity in stage $C$, and in subsequent stages only loses it gradually. We can say that it is made to postpone its disappearance by becoming temporarily infected by the high positive growth-intensity in the endopodite and in limb 1. The intensity of growth-change, whether regressive or positive, is greater in each phase in the endopodites.

In females (Fig. 2), this last rule also holds. The tendency for regression to be more intense posteriorly is also obvious. But during the succeeding phase of positive heterogony, the high point is posterior (clearly shown in endopodites, stage $C$), perhaps in correlation with the similar-shaped gradient in abdominal segments (see Day's note). The gradient for the next stage (stability) is practically horizontal.

To sum up, both sexes show evidence of different growth-gradients succeeding each other in the same region, and the changes in growth-gradients are themselves graded. The changes in the female might be produced by a mere change of sign, but in the male a new growth-centre clearly originates in the anterior region, confirming Day's suggestion. Any changes are usually shown at an earlier stage by the high point of a gradient than by its lower portions. In addition, there is always a medio-lateral growth-gradient, shown by the fact that the growth-changes in the endopodites are always more intense (and are initiated earlier).

## Growth Gradients in the Abdomen of the Shore-Crab

By Dr. J. H. Day, Armstrong College
Newcastle-on-Tyne

A STUDY of the growth gradients in the abdomen of *Carcinus mænas* gives results which may have a wider application.

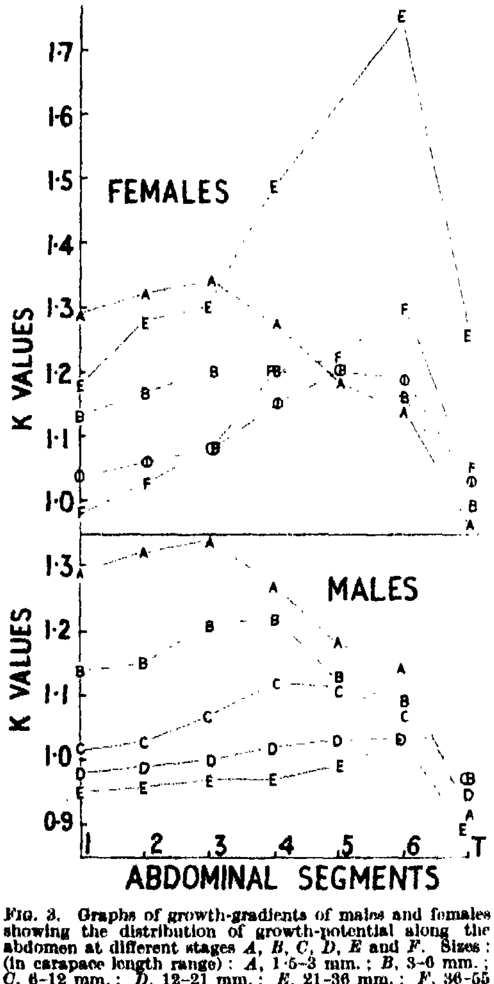



FIG. 3. Graphs of growth-gradients of males and females showing the distribution of growth-potential along the abdomen at different stages *A*, *B*, *C*, *D*, *E* and *F*. Sizes: (in carapace length range): *A*, 1·5–3 mm.; *B*, 3–6 mm.; *C*, 6–12 mm.; *D*, 12–21 mm.; *E*, 21–36 mm.; *F*, 36–55 mm. *CD*, denoted by Φ, are identical in the female and *EF*, denoted by *E*, are identical in the male.

Measurements of the breadth of the abdominal segments taken from 560 crabs of all ages were plotted against the body-size on a double logarithmic grid. Growth coefficients were then determined from the value of $k$ in Huxley's formula $y = bx^k$. A graph giving the distribution of these $k$ values along the abdomen shows changes in the shape of the growth gradients of that organ during development (Fig. 3).

In the youngest or 'unsexable' crabs (graph *A*) the growth-centre or peak of the curve lies in segment three; at maturity (graph *E*) the growth-centre is in segment six. The intervening stages (graphs *B*, *C*, *D*) mark a transition from one centre to the other.

It must be stressed that gradients in the abdomen are parts of a more general gradient permeating the whole body, and that a change in one affects the other. Dealing only with the local gradients, however, it may be said that there are two possible explanations of the change in the position of the growth-centre. (1) The growth-centre actually migrates from segment three to segment six. (2) The growth-centre in segment six is of separate origin and its activity increases while the influence of the proximal centre declines, so that the high point of the curve moves from one centre to the other. These two possibilities are not mutually exclusive.

The arguments in favour of a separate origin of the growth-centre in segment six are too lengthy to be set out in detail here, but it may be stated that sexual differences in the growth of the abdomen appear first in the sixth segment, but not in the proximal segments until sexual maturity. The growth-centre in segment six is thus differential in regard to sex, whereas the proximal one is not. Also the distal growth-centre arises when differences in sexual appendages first becomes marked, and its influence increases with approaching maturity, when it dominates the growth of the whole abdomen. For these reasons we may correlate the gradient of which this is the centre with the phases of sexual development and call it a sexual growth-gradient.

It is believed that this is the first recorded case of an organ passing from the influence of one gradient to another, the second of which is correlated with sexual development.

A full report of this work has recently been published in the Report of the Dove Marine Laboratory (Third Series, No. 3).

# Winter Hardiness of Crops

IN the U.S.S.R., where autumn-sown cereals may experience temperatures so low as −20° C., or a covering of snow for two or three months, winter hardiness, and particularly frost resistance, is an important aspect of crop studies. A recent publication of the Institute of Plant Industry (*Bull. App. Bot., Genetics and Plant Breeding*, No. 6, Series 3, Leningrad, 1935) is devoted to contributions on this subject, some of these coming from the Winter Resistance Laboratory of the Institute; adequate English summaries are provided.

Determinations of frost resistance were made by bringing the plants, with the roots undisturbed in the soil, to the laboratory and subjecting them to temperatures such as −14° C. The results show that the capacity of a crop to survive after such low temperatures varies during the winter period, and that it is much influenced by the conditions of growth in the vegetative period prior to the arrival of frost. Thus, the plants investigated became 'hardened' when subjected to suitable weather conditions in the autumn. The authors emphasise that, while it is important to sow in time for the crops to become 'hardened' before the advent of the severe

weather, it is equally important that the crop should not be so advanced that it emerges from the state of hardness before winter is over. Whether or not a plant is in the state that it can acquire or retain hardiness, cannot be judged by external appearance; it is governed more by the stage of development than by state of growth.

In Great Britain, capacity to withstand water logging is a more important aspect of winter hardiness than frost resistance, and it is interesting to note from these contributions that 'hardening' increases resistance to water-logging as well as to frost, and that the curves of both were similar from the time of sowing throughout the winter.

Moshkov makes an interesting contribution on photoperiodism and hardiness, showing how plants introduced from regions of comparatively short day-length display a lowered resistance to frost when grown in regions with a greater length of day, such as near Leningrad; the resistance is restored if the plants are shaded for some hours daily in such places, thus artificially shortening the day. The author is of opinion that plants are not so winter hardy when grown in places having a day-length differing from that of the region where they grow in the wild state. This work will probably throw light on some important problems connected with the introduction of strains of pasture plants from country to country, and help to explain the value of the indigenous strains.

In a study of the effects of a covering of snow, it is pointed out that the plants are killed if the layer is too thin or too thick. It has hitherto been assumed that the harmful effect of a deep layer of snow is due to the exclusion of air; but the authors show that it is caused by the exhaustion of the carbohydrates in the leaves and nodes, followed by a breakdown of proteins, and the subsequent attack of the weakened plants by 'snow mould'.

# Metric System for Maps

WE have received a copy of the memorandum submitted by the Council of the Decimal Association to the Departmental Committee on the Ordnance Survey, appointed by the Minister of Agriculture and Fisheries, now sitting. The memorandum urges the adoption of the metric system for British maps.

The Association is naturally strongly in favour of the suggestion of the Director-General of the Ordnance Survey that a metric grid for maps of Great Britain would be preferable to a yard grid (see NATURE, February 1, p. 196). It also directs attention to the want of simplicity which exists among the present scales of maps. Of the eight different scales, only three are simple ratios to the actual. The Association agrees with the Director-General that if a grid system is adopted there are great advantages in having map scales exact multiples of one another.

In the accompanying table the existing Ordnance Survey scales are contrasted with the scales which it is suggested should replace them.

"It will be seen," the memorandum remarks, "that, with one exception, there is only a negligible difference of ratio between the existing and the suggested improved scales." Whether these changes could be brought about or not must largely depend on being able to educate the public to appreciate the advantages of the metric system. The Ministry of Transport might assist by having the distances on road finger-posts shown in kilometres, in brackets, after the present mileage figures. By this means the numerous map and road users could readily be reached.

| Suggested Natural Scale | | Scales of Existing Maps | |
|---|---|---|---|
| Denomination (mm. to km.) | Ratio 1 to | Inches to mile | Ratio 1 to |
| 1 | 1,000,000 | $\frac{1}{15.782}$ | 1,000,000 |
| 2 | 500,000 | $\frac{1}{10}$ | 633,600 |
| 4 | 250,000 | $\frac{1}{4}$ | 233,440 |
| 8 | 125,000 | $\frac{1}{2}$ | 126,720 |
| 16 | 62,500 | 1 | 63,360 |
| 100 | 10,000 | 6 | 10,560 |
| 400 | 2,500 | 25.344 | 2,500 |
| 800 | 1,250 | 50,688 | 1,250 |

Since the chief reference to the Departmental Committee is concerned with the revision of the Ordnance maps, it would appear to be a favourable opportunity, which may not occur again, for a serious consideration of the adoption of the metric system, now used in every Continental country. At the same time, a simplification of the scales could be taken in hand. Anyhow, nothing, we suggest, should be done to hamper the eventual adoption of the metric system, if it cannot be introduced at present.

# Design of Cargo Steamers

IN the aftermath of the Great War, probably no branch of activity suffered so much disorganisation as that of shipbuilding. To make good the deficiencies of the moment, standard ships were hurriedly built with little or no relation to the particular work which each would have to do, and with inadequate attention to other details of design. The lean years which followed made the times difficult even for the most efficient of fleets, and, without any foundation on which to build up a post-War policy, the business of shipbuilding has been in much the same plight as a ship the steering gear of which has broken down.

From this unsatisfactory condition there is now some prospect of release, and in a paper entitled "New Cargo Steamers: Efficiency Problems" read before the North East Coast Institution of Engineers and Shipbuilders on March 6, Mr. J. Leslie Batey discusses the question of obsolescence and its bearing on the probable demand for new tonnage. A chart showing tonnage under construction in the United Kingdom since 1911 and the corresponding figure

of twenty years earlier gives a clear idea of the author's view that there will, in the next five years or so, be a considerable increase of shipbuilding, and, therefore, of prices above the present low levels. He points to the advantage, where immediate profits can be dispensed with, to be derived from building when prices are low and obtaining a few years later enhanced rates together with capital appreciation.

On the technical side it is shown that for efficiency, design and specification must be suitable for the particular trade for which the vessel is intended, that features which are nothing more than fads must be eliminated, and that accommodation for officers and crew should be such as to attract the best type of men. Drawings of the S.S. *Dumfries* are appended to show the author's idea of a good plain cargo vessel with a well-balanced specification and arranged on simple and efficient lines. Questions of strength and weight should be left to the classification societies as the greatest authorities on the subject and the depositories of data relating to structural trouble experienced with ships in service. Stream-lining of the rudder and stern frame is recommended as one of the conditions essential to efficiency.

On the subject of service speed, the author indicates the retarding effects on a vessel in a sea-way due to rolling, pitching, heaving and yawing, and the additional fluctuations due to orbital velocity of the surface of the water which in waves 6½ ft. high and 100 ft. in length has been found to be as much as 2¾ knots. To maintain the service speed against such adverse conditions, he considers it advisable to give the vessel a form suitable for a speed ½–3 knots (according to trade) in excess of the service speed demanded, and suggests that on trial the engines should be able to develop 15 per cent surplus power on the Skelmorlie mile (or 10 per cent on Hartley). As a standard of propulsive efficiency, Ayre's basis is taken and data are adduced regarding four types of vessel, including one of the *B* Standard vessels, and their performances are analysed and compared in detail on this basis.

# Embryology of Angiosperms

AN article by Dr. P. Maheshwari from *Current Science* of June last, entitled "Progress of Work in India on the Embryology of Angiosperms", reviews the considerable amount of research already completed in his own department at the Agra College and at other Indian botanical centres.

Contributions from Agra include a series of papers by B. M. Johri on the embryology of the Alismataceæ as illustrated by species of *Limnophyton* and *Sagittaria*, with a review of previous work on the family: there is some variability in development in the embryo-sac and in endosperm formation. B. L. Gupta gives a comparative account of previous work on the embryology of the Potamogetonaceæ and contributes results of his own researches on pollen and ovule-development in *Potamogeton crispus* and *Wolffia arrhiza*. *Wolffia* shows several important differences in this respect from the allied genus *Lemna*. Similar work on the Centrospermales is found in studies by H. R. Bhargava on *Boerhaavia* (Nyctaginaceæ) and *Mollugo* and *Trianthema* (Aizoaceæ) and by V. Puri and B. Singh on *Digera* (Amarantaceæ). In a comparative review of embryological work on the Centrospermales, Puri and Singh suggest the separation of the Portulacaceæ, Basellaceæ and Caryophyllaceæ as a distinct order. Species of *Neptunia* (Mimosaceæ), *Eclipta* (Compositæ) and *Cuscuta* have also been studied. In a paper on the gametophytes of *Berberis nepalensis*, Johri discusses the relationship between the families Ranunculaceæ and Berberidaceæ. The marked similarity in members of the two families in sporogenesis and gametogenesis suggests their close alliance in spite of differences in floral structure which have been used to separate them in distinct orders.

Dr. Maheshwari introduces a study of the life-history and anatomy of *Ephedra foliata* with an account of the development of the two gametophytes. With B. Singh he contributes an account of the morphology and anatomy of the fern, *Ophioglossum fibrosum*. In his general article referred to above, he stresses the importance of a study of the plants in their entirety in approaching a natural system of classification. He also refers to the serious difficulty arising from paucity of literature in India, and pleads for a more general exchange of reprints and journals.

# Experiments in Salmon Marking in Norway, 1935

A NOTABLE paper has just been published by Prof. Knut Dahl and Sven Sømme on this subject (*Statens Forsøksvirksomhet for Ferskvannsfiskeri, Oslo*. I. Matem.-Naturwid. Klasse, 1935. No. 12), and it is demonstrated that *Salmo salar* has a wider range in its migratory movements than was supposed, or at any rate than had been proved in Europe.

The Scottish coastal marking carried on for a number of years in the Moray Firth and east and north coasts of Sutherland certainly resulted in a large number of recaptures and records published by the Fishery Board for Scotland—up to 38 per cent of the fish marked in one of the seasons—and shed a good deal of light on the movements of fish round the coast. Indications were collected also from the capture of salmon, at infrequent intervals, at far distant points, that the Atlantic salmon ranged widely. But the Norwegian results now published prove this to be the case.

The authors are of opinion that the high percentage of recaptures—reaching 48 per cent—is due really

to the fact that the marks used had the place of origin indicated upon them ("Zool. Museum, Oslo") as well as a distinguishing number, and that on this account the reporting of recaptures was more complete. In the Scottish operations we relied upon a wide circulation of the occurrence of the marking and the offer of rewards, but on one or two occasions it did happen that the report of a recapture was obtained only after the fish had made a railway journey to market. Also, the Norwegian marks were inserted not in the base of the dorsal fin, but were wired through the back just in front of the dorsal fin, where the mark was more conspicuous.

The greatest distance recorded from the Scottish marking was about 620 miles, being the shortest distance from the Spey round the north of Scotland to the Eden in Cumberland. On the Pacific coast of North America 'tagging' had shown greater distances than this, and operations at the Alaskan Peninsula had yielded not only long distances but also some interesting information about the pace of travel at different times of the year. Newspaper reports had even told of a salmon (*Onchorynchus*) from this set of operations that followed the line of the Aleutian Islands and had been captured in Kamchatka by Japanese fishermen. This journey is well over 1,000 miles. From the west of Vancouver Island also fish had gone south to the Columbia River, a distance of 800 miles.

The Norwegian records now give one example of a fish having travelled from Titran on an island off the Trondhjem Fiord, north to the Wyg River in the Gulf of Onega in the White Sea, a distance of 2,500 kilometres, which is approximately 1,500 miles. Lesser distances are 1,100 km., 800 km. and 700 km. It is interesting to notice also that one fish, marked at Rong not far from Bergen, had gone south-west across the North Sea to Montrose, the interval of time being 19 days and the distance 550 km., which is approximately 350 miles.

This paper opens up a new vista of the range of *S. salar*, and some interesting particulars are given also about smolt marking carried out by Dr. Gunnar Alm in the Baltic, and showing wide movements.

W. L. Calderwood.

## Educational Topics and Events

London.—Mr. D. G. Catcheside, lecturer in botany in King's College, has been awarded a Rockefeller fellowship in cytological genetics. He is to spend a year in Dr. T. H. Morgan's laboratory at the California Institute of Technology, Pasadena, beginning in September 1936.

St. Andrews.—The Senatus Academicus has resolved to confer the honorary degree of LL.D. on the following, among others, at the graduation ceremonial to be held in June: Mr. David Anderson, of the firm of Messrs. Mott, Hay and Anderson, consulting engineers, London; Prof. J. E. Littlewood, Rouse Ball professor of mathematics in the University of Cambridge; Major F. J. J. Ney, executive secretary, National Council of Education of Canada, Toronto, Canada; Prof. E. W. Reid, emeritus professor of physiology, University College, Dundee.

Sheffield.—Lord Crewe, Chancellor of the University, will open the new University Students' Union building on Saturday, May 2. The building was made possible through the generosity of Alderman J. G. Graves, who gave £15,000, the cost of the building. Before opening the building, Lord Crewe will confer honorary degrees upon the following, among others: Sir Charles Grant Robertson, Vice-Chancellor of the University of Birmingham; Sir Harold Hartley, vice-president and director of scientific research of the L.M.S. Railway Company; Sir Frank Smith, secretary of the Department of Scientific and Industrial Research and secretary of the Royal Society; Sir Harold Carpenter, professor of metallurgy in the Royal School of Mines.

The American National Research Council has administered during the past sixteen years a post-doctoral fellowship scheme, financed by the Rockefeller Foundation, involving the expenditure of nearly four million dollars. It seems that the Foundation, while continuing to take a keen interest in the post-doctoral fellowship principle, will not continue its support on the same scale and in the same way as in the past; and some anxiety has, in consequence, been aroused in university circles as to ways and means for ensuring the maximum of opportunity for minds capable of productive scholarship. At the thirty-seventh annual conference of the Association of American Universities held at Cornell University last November, this question was discussed in papers by Prof. F. R. Lillie of the National Research Council, Dr. K. T. Compton, president of the Massachusetts Institute of Technology and Dr. Ray Lyman Wilbur, president of Stanford University. The National Research fellowships are comparable in aim and scope with the fellowships instituted in Great Britain in 1891 by the Royal Commission for the Exhibition of 1851 and, like them, have this great advantage over fellowships awarded by universities, that the field of selection is enormously wider. Dr. Compton's paper outlined an ingenious plan, the essential features of which are: the offer by each of a group of associated universities of fellowships for research to be carried out within it, and the assumption of the task of selecting fellows by an independent board which receives applications from candidates throughout the country. A schedule of stipends uniform for all the universities would tend to prevent candidates' choice from being influenced by financial considerations. Such a scheme would, Dr. Compton believes, if subscribed to by a sufficient number of universities, be subsidised by the Rockefeller and other foundations.

Harvard University celebrates this year the three-hundredth anniversary of its foundation. The occasion is to be marked by inaugurating two schemes of high importance, the outcome of what is termed "a new appraisal of the University's place and function in the life of the nation". One of them is for the creation of 'university professorships' of a novel kind, affording to teachers and scholars of unusual scope and ability broader opportunities than have hitherto been available in American universities. The Harvard authorities are impressed by the realisation that all subjects which are intensively studied lead into other subjects, and the occupants of the new chairs, while not exactly "professors of things-in-general", will be limited by the scope of their own

interests rather than by the traditional division of subjects. It is hoped by this means to "fortify the university as a whole in contrast to its separate parts or departments". It is sought to obtain for each chair an endowment of half a million dollars to provide not only an adequate salary, but also an allowance for assistants, both for instruction and for investigations. In thus safeguarding itself against departmentalism—that insidious disease incidental to the growth of specialisation in universities—Harvard has given a lead that may prove to have very far-reaching results. It stands for a movement the very antithesis of the tendency, exemplified in Russia, to abandon the ideal of a great community of scholars working in all fields in the best environment in which to promote breadth of understanding, and to substitute that of separate schools or research institutes each concentrating upon its own field in isolation. The other scheme is for "national scholarships" intended to open the door of opportunity for study at a great endowed university to more of the most promising youth from every part of the country. They are to provide "as much as may be needed up to $1000 in the first year and $1200 thereafter" and will not carry an implication that all the recipients are poor.

## Science News a Century Ago

### The British Museum

*The Times* of April 13, 1836, commenting on a return dealing with the British Museum issued in April 1836, said: "The receipts of the British Museum last year were £19,603 8s. 0½d., of which the public money voted by Parliament amounted to £19,076 4s. 6½d., leaving a balance of £527 3s. 6d. The estimated expenditure for the present year is £23,600. . . . There is in the present estimate a special item of £2,000 for the purchase of manuscripts, and another of £500 towards making moulds of the Elgin marbles. The principal item in which there is an increase this year is in salaries to the minor officers and servants . . . and to a provision for an increased number of copyists for the purpose of furnishing the public in the reading-rooms with a complete catalogue of the printed books within the current year. . . . The number of visitors to the general collection last year was 289,104."

### Airy's Lectures at Cambridge in 1836

WHEN Airy was appointed Astronomer Royal, he stipulated that he should be allowed to give a final course of lectures at Cambridge. Lord Auckland, the First Lord of the Admiralty, agreed to this, but his successor Lord Minto refused the necessary permission. When this was known in Cambridge, a petition was sent to Lord Minto, who then yielded. Referring to this in his "Autobiography", Airy wrote: "On April 18 I went to Cambridge with my wife, residing at the Bull Inn, and began Lectures on April 21st: they continued [apparently] to May 27th. My lecture room was crowded [the number of names was 110] and the lectures gave great satisfaction. I offered to the Admiralty to put all the profits in their hands, and transmitted a cheque to the Accountant General of the Navy: but the Admiralty declined to receive them."

### The Royal Society

AT a meeting of the Royal Society held on April 21, 1836, Murchison being in the chair, a communication from Prof. J. F. Daniell was read entitled "Additional Observations on Voltaic Combinations". "The author," the report said, "has found that the constant battery, described in a former communication, might be rendered not only perfectly steady in its action, but also very powerful, as well as extremely efficacious and convenient for all the purposes to which the common voltaic battery is usually applied. With this view he places the cells which form the battery in two parallel rows, consisting of ten cells in each row, on a long table, with their siphon-tubes arranged opposite to each other and hanging over a small gutter, placed between the rows, in order to carry off the refuse solution when it is necessary to change the acid. Having observed that the uniformity of action may be completely maintained by the occasional addition of a small quantity of acid, he is able to dispense with the cumbrous addition of the dripping funnel; an arrangement which admits with facility of any combination of the plates which may be desired."

### Bichat's Theory of Life

"EVERYTHING around human beings, according to M. Bichat, tends constantly to their destruction, and to this influence they would necessarily yield, were they not gifted with some permanent principle of reaction. This principle is their life, and a living system is necessarily always engaged in the performance of functions, whose object it is to resist death. Life, according to Bichat, is the state of being produced by the possession and exercise of what he calls the vital properties; yet he does not always adhere with logical strictness to this definition; but rather uses the term sometimes to designate the vital properties collectively, and this is perhaps the best and most convenient sense. His essential doctrine, however, is that there is no one single individual presiding principle of vitality, that animates the body, but that it is a collection of matter gifted for a time with certain powers of action combined into organs, which are thus enabled to act, and the result is a series of functions, the connected performance of which constitutes a living being." (*Lancet*, April 22, 1836.)

### Scientific Lectures in Ealing

IN an interesting contribution to *The Times* of April 23, 1836, a correspondent said: "The beautiful village of Great Ealing, Middlesex, has been kept in a most pleasing state of excitement during the last week by the opening of an institution patronized by the principal of the nobility, clergy and gentry of the neighbourhood and entitled 'The Union for the Moral and Intellectual Improvement of the Industrious Classes of Great Ealing and its Vicinity'." The opening of the institution took place in the Great Hall of Messrs. Nicholas's Ealing School on April 11, the Rev. Mr. Smith, the vicar, presiding. "Mr. Bird, lecturer at Eton College, Harrow School, Messrs. Nicholas's School, etc. was appointed to open the institution with a course of three lectures on astronomy, he having risen from the working class by his own exertion and perseverance to the high honour of lecturing before royalty. . . ."

# Societies and Academies

## PARIS

Academy of Sciences, March 9 (*C.R.*, 202, 785–884). LOUIS LAPICQUE : Notice on the late Ivan Petrovitch Pavlow. ALFRED LACROIX : The volcanic rocks of Pitcairn Island (Southern Pacific Ocean). JOSEPH MONTGOLFIER : An internal combustion motor. A sealed letter deposited in 1784. EDOUARD LE ROY : The formulæ of Lorentz. EMILE JOUGUET : Waves of shock and continuous waves of certain gases. RICHARD FOSSE and PAUL DE GRAEVE : The synthesis of cyanamide by the oxidation of formaldehyde and ammonia. By the oxidation of a solution of formaldehyde and ammonia with calcium permanganate, cyanamide was produced, in quantity about 2 per cent of the aldehyde oxidised. HYACINTHE VINCENT and FRANCOIS MOREL : The neutralising action *in vitro* of certain chemical bodies on the toxic power of curare. The substances found previously to exert a neutralising effect on certain toxins and alkaloids were found to exert a similar action on curare. CHARLES POISSON and ANDRÉ SAVORNIN : The magnetic anomalies at the summit of Rantoandro. Certain basalt peaks in Madagascar show intense magnetic anomalies, possibly sufficient to be dangerous to aeroplanes flying by compass. EDM. SERGENT, A. DONATIEN, L. PARROT and F. LESTOQUARD : The evolutive cycle of the sporozoan *Theileria dispar*, the agent of the bovine theilerosis of Mediterranean countries, in the ox and in a tick. JACQUES DE LAPPARENT was elected *Correspondant* for the Section of Mineralogy in succession to the late Georges Friedel. PAUL LÉVY : Observations on a note of M. Denjoy. LEONIDAS KANTOROVITCH : The properties of linear semi-ordinate spaces. F. LEJA : Certain functions of ensemble in any metric space. ARMAND RAUCH : The integral algebroids of $\rho$ order admitting angles of divergence $\pi/\rho$. MICHEL LUNTZ and ANDRÉ JAPY : The dispersion of heat by turbulent convection and the measurement of the turbulence. PAUL SCHWARZ : The permanence of alternate eddies in a rectilinear canal. JEAN DELSARTE : A problem of diffraction. ALEXANDRE MARCEL MONNIER and JOSEPH BAZIN : A generator producing sinusoidal oscillations of constant amplitude over a very extended range of frequencies. ROMOLO DEAGLIO : The thermo-electric and voltaic properties of normal and abnormal metallic films. The normal film can be distinguished by opposing it to the massive metal in a cell, when no E.M.F. should develop. It is shown that two gold conductors, one thick and the other of green film thickness, are voltaically equivalent but thermo-electrically different. G. WATAGHIN : The interaction between protons and neutrons. MAURICE ROULLEAU : The influence of temperature on the sensibility of rapid photographic emulsions. The results of experiments on a dozen different emulsions are shown graphically, with density and temperature of the plate as variables. The sensibility was reduced as the temperature was lower. RENÉ DE MALLEMANN, PIERRE GABIANO and F. SUHNER : A new absolute determination of the magnetic rotatory power of water. With the apparatus used the rotations observed were of the order of 55°. For the green mercury line the Verdet constant at 11·5° C. was found to be $1{\cdot}543 \times 10^{-2} \pm 0{\cdot}001$ minutes of arc. MARCEL LECOIN : The deviation of the $\beta$-rays on nitrogen nuclei. PIERRE PREISWERK and HANS VON HALBAN, JR. : The relative positions of the resonance levels for the capture of neutrons by silver and by iodine. MAURICE ENGELDINGER : Study of the formation, in dilute solution, of the colloidal resins obtained by the action of formaldehyde on resorcinol. CLÉMENT DUVAL : Ferric oxalate. From a study of the ion transport in absolute alcoholic solution the author concludes that this substance is not ferric oxalate, $Fe_2(C_2O_4)_3 + 4\,H_2O$, but behaves as ferritetrahydrin ferrioxalate, $Fe(C_2O_4)_3.Fe(H_2O)_4$. LIOU OUI TAO and WANG SHIH MO : The equilibria between III chloropentammine cobalt sulphates and their sulphuric solutions. ARMAND MARIE DE FICQUELMONT : The physicochemical study of the neutralisation of aqueous solutions of the metaphosphimic and diimidotriphosphoric acids. PIERRE DONZELOT and MAURICE CHAIX : The Raman effect in organic sulphides. JEAN ETTORI : The colour reaction of titanium with ascorbic acid and other molecules containing the group $-C(OH)=C(OH)$. The formation of an orange yellow complex with titanium salts is a general property of the above group, named the orthodiol-ene group. RAYMOND PAUL : The synthesis of the Carlina oxide. This substance, extracted from the roots of *Carlina acaulis*, appears to be the only acetylene derivative occurring in Nature. A compound of the same composition has been prepared synthetically, resembling the natural product, but not quite identical, possibly on account of incomplete purification. JACQUES BOURCART : The marine Quaternary on the coast of Cap Saint-Vincent in the estuary of the Sado. ANDRÉ SAVORNIN : The possibilities of magnetic prospecting in Madagascar. An account of the difficulties encountered and suggestions for reducing errors. LOUIS EBLÉ : The values of the magnetic elements at the Val-Joyeux station (Seine-et-Oise) on January 1, 1936. FRANCIS ROGER SPENCER HENSON : The large Foraminifera of the Oligocene of Palestine. MLLE. FERNANDE FLOUS : The natural classification of the Pinaceæ. EMILE MICHEL-DURAND : The metabolism of the phosphorus compounds of the acorn in the course of germination in the light. HENRI MARCELET : The presence of hydrocarbons in the product removed by the deodorisation of olive oil. The examination of the substances removed by treatment of olive oil with superheated steam proved the presence of seven hydrocarbons. The original olive oil contained only 0·007 per cent of these hydrocarbons. G. and M. ARNAUD : Virus diseases of the Prunus group of Rosaceæ. PIERRE FEYEL : The influence of the renal secretion of urea on the working of the resorption apparatus of chlorides in mice. J. LEGENDRE : The continental penetration of the maritime mosquito. The mosquito *Ædes punctatus*, which normally breeds in salt water pools, can penetrate several kilometres inland, depending on the distance the sea-water reaches from the coast. PAUL BONNEVILLE : The ectodermic origin of certain parts of the royal adipose tissue of termites. MME. VÉRA DANTCHAKOFF : The capacity of an induced ovary of a bird to condition secondary sexual characters. GEORGES TANRET : The comparative velocities of hydrolysis of some glucosides under the influence of ultraviolet rays, acids and diastases.

## MOSCOW

Academy of Sciences (*C.R.*, 4, No. 6–7; 1935). A. MINJATOV : The interpolation problem with functions of several complex variables. A. A. ARTJUCHOV : A

new evaluation of $g(n)$ in Waring's problem. A. PLESSNER: Conjugated trigonometric series. A. S. BAKALIAJEV: The principle of radiation generalised in a stationary problem in the space of the elasticity theory. A. A. GRÜNBERG and D. I. RJABCHIKOV: Contribution to the problem of the strength of isomeric bases of the type $[Pt(NH_3)_2(OH)_2]$. K. S. TOPCHIJEV: (1) Nitration method of 6-methoxy-8-nitroquinoline. (2) Cases of mobility of the nitro-group. Mobility of the nitro-group in 6-methoxy-5-8-dinitroquinoline. A. P. TERENTIEV, E. V. VINOGRADOVA and G. D. GALPERN: Diazometric determination method for carbohydrates. G. C. MOOR and B. N. ROZHKOV: Finding of bituminous rocks in the Cambrian deposits of north-west Yakutia (Anabar River). I. SEDLECKIJ and B. BRUNOWSKIJ: Structure of humic acid and its relation to lignin and to coals. N. N. MEDVEDEV: The contributive effect of cold to irradiation in the production of mutations. N. S. BUTARIN: The chromosome complex of the arkhar (*Ovis polii karelini*, Sev.), the kurdiuchny ram (*O. steatopyga*) and their $F_1$-hybrid. D. A. HENKEL and A. A. KUBYLIN: The drought-hardening of the potato before sowing. J. V. RAKITIN and N. N. SUVOROV: The effect of temporary anærobiosis on the sprouting of young potato tubers. A. J. IVANOV: Notes on some birds of Tadzhikistan. A. M. POPOV: A new genus and species, *Lycozoarces hubbsi* (Pisces, Zoarcidæ), of the Okhotsk Sea.

### ROME

*Royal National Academy of the Lincei* (*Atti*, **22**, 93–180; 1935). A. BEMPORAD: Increased precision in recent reductions of the Astrographic Catalogue. N. SPAMPINATO: Extension to the bicomplex field of two theorems of Levi-Civita and of Severi, through the homologous functions of two complex variables (2). G. PALOZZI: Projective applicability of plane lattices. U. BROGGI: Series development of Laguerre polynomials. G. SCORZA DRAGONI: Some theorems of means encountered in dynamics. U. BROGGI: System of infinite linear equations. A. TERRACINI: Projective lines of a surface. L. SONA: Translocirculatory current which invests a bilateral lamina. M. PASTORI: Problem of Clebsch (1). C. M. MALDURA: Chemical researches on the Orbetello lagoon with regard to the biology (2). V. CAGLIOTI: Structure of ferric phosphate. $FePO_4$ prepared by the action of $Na_2HPO_4$ on $FeCl_3$ in presence of $CH_3COONa$ crystallises in one phase isomorphous with quartz. C. NEUBERG and W. CAHILL: Total enzymatic hydrolysis of condroitin-sulphuric and mucoitin-sulphuric acids into their components. G. SCAGLIARINI: Colour reaction between nitroprusside and sulphites (Bödeker's reaction). The formation of the complex ion $[Fe(CN)_5NOSO_3]''''$ is demonstrated. P. PRATESI and A. ZANETTA: Reaction between pyrrole and isatin (pyrrole-blues) (3). Pyrrole blue A has been obtained in the pure crystalline state, but the structure is not yet certain. H. BREUIL and C. A. BLANC: Discovery *in situ* of a new skull of *Homo neanderthalensis* in the deposits of Saccopastore (Rome). E. SANERO: Presence of prehnite at Monte Loreto in Liguria. A mineral from this source is shown to be prehnite, $H_2Ca_2Al_2(SiO_4)_3$. G. AMANTEA: Method of estimating the antineuritic vitamin $B_1$ using the conception of the beriberi quotient $Q_b$. G. AMANTEA: Action of some chemical substances on clonus due to atropinisation of the cortical sensory-motor centres.

### WASHINGTON, D.C.

*National Academy of Sciences* (*Proc.*, **22**, 81–149, Feb. 15). JOHN M. IDE: Comparison of statically and dynamically determined Young's modulus of rocks. The specimen, in the form of a cylinder 20 cm. or 25 cm. long and 1·59 cm. or 5·08 cm. in diameter respectively, is placed upright on a thick steel disk, its lower end, to which is cemented a metal foil, being separated from the steel by a sheet of mica. Alternating voltage of variable frequency is applied to the foil and steel disk, and when its frequency resonates with the longitudinal frequency of the specimen, the latter vibrates with increased amplitude and radiates sound. From this frequency Young's modulus is computed. The values obtained agree well with those obtained by the seismic wave method. Generally, the dynamic values are 4–20 per cent higher than those determined statically for the same specimens, due probably to the presence of minute cracks and cavities. Variations in the same rock appear to be due to variations of density and of elastic properties. J. v. NEUMANN: (1) Continuous geometry. A continuation of recent work tending towards the elimination of the notions of points, lines and planes from geometry. (2) Examples of continuous geometries. JOSEPH MILLER THOMAS: Complete differential systems. EDUARD ČECH: On general manifolds. G. A. MILLER: General theorems applying to all the groups of order 32. M. R. HESTENES: Minimax principle for functions. E. B. WILSON and M. M. HILFERTY: On the explosiveness and destructiveness of the 1918 epidemic [of influenza in the United States]. A statistical discussion. CHESTER STOCK: Sespe Eocene Didelphids. The first record of these marsupials in the North American upper Eocene. JOHN H. LAWRENCE and ERNEST O. LAWRENCE: The biological action of neutron rays. Making certain assumptions about the amount of ionisation likely to be produced in the tissues of rats, a procedure was devised whereby two similar batches of rats were exposed for different periods to neutrons and X-rays estimated to produce equal amounts of ionisation. The blood picture and general health of the animals were observed. Per unit of ionisation in the rat, neutrons are possibly five times as effective biologically as X-rays. The results suggest that workers using neutron generators should have adequate protective screening, presumably by substances containing a high proportion of hydrogen and therefore good absorbers of neutrons. RAYMOND E. ZIRKLE and PAUL C. AEBERSOLD: Relative effectiveness of X-rays and fast neutrons in retarding growth. Wheat seedlings just showing the primary root were submitted to equivalent doses of neutron and X-ray radiation. Plotting retardation of growth against dosage, the experimental points cluster about the same smooth curve if the scale of X-ray dosage is twenty times that of the neutron dosage. Consideration of the mode of ionisation suggests that a unit of neutron irradiation produces twice as much ionisation in tissue as a unit of X-rays; hence one ion produced in tissue by neutrons is as effective as ten ions produced by X-rays. If this ratio (10 to 1), compared with that of the previous paper (5 to 1), indicates a real difference for different tissues, the therapeutic use of neutrons instead of X-rays, for example, in treating tumours, is indicated; but more detailed determinations on the rat or other biological object are required to support this suggestion. EDISON PETTIT: On the colour of Crater Lake water. This

lake in southern Oregon is in the crater of an extinct volcano, the walls of which mostly rise abruptly to 500–2,000 ft. The only known source of water supply is the precipitation within the crater; the average depth is 1,500 ft. The water of the lake is remarkably blue in appearance. It is comparatively pure and free from suspended sediment and dissolved matter. Laboratory tests of specimens suggest that the blue colour is due to scattering of light by water molecules.

A. E. MIRSKY: The visual cycle and protein denaturation. Recent work on conjugated proteins suggests that visual purple is such a compound, a carotenoid-protein. Light denatures visual purple, forming a compound, visual yellow, in which the carotenoid group is loosely bound to the protein; in the dark, denaturation reverses. The function of retinene is to provide an increased absorption coefficient in the visible spectrum, to sensitise the protein.

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## Forthcoming Events

### Monday, April 20

VICTORIA INSTITUTE, at 4.30 (at the Central Hall, Westminster).—G. R. Gair: "The Races and Peoples of the Early Hebrew World: a Study in Ethnology".

ROYAL SOCIETY OF ARTS, at 8.—Dr. R. E. Stradling: "Problems of Road Research" (Peter le Neve Foster Lectures. Succeeding lectures on April 27 and May 4).

### Tuesday, April 21

SOCIETY FOR STUDY OF INEBRIETY AND DRUG ADDICTION, at 4 (at 11 Chandos Street, London, W.1).—Dr. J. D. Rolleston: "On Snuff Taking".

INSTITUTE OF PATHOLOGY AND RESEARCH, St. Mary's Hospital, W.2, at 5.—Pathological Research in its Relation to Medicine. Sir Almroth Wright, F.R.S.: "Some Results of Recent Research".

### Thursday, April 23

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. J. D. Cockcroft: "The Transmutations of Matter by High-Energy Particles and Radiations" (Twenty-seventh Kelvin Lecture).

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FARADAY SOCIETY, April 20–22. General Discussion on "Disperse Systems in Gases: Dust, Smoke and Fog" to be held at the University of Leeds.

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## Official Publications Received

### Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 31: The Constitution of the Tin-Rich Antimony—Tin Alloys. By Prof. D. Hanson and W. T. Pell-Walpole. Pp. 12. Free. Series A, No. 32: Influence of Surface Cuprous Oxide Inclusions on the Porosity of Hot-Tinned Coatings on Copper. By Dr. W. D. Jones. Pp. 8. Free. Series A, No. 33: The Hot-Tinning of Copper; the Attack on the Basis Metal and its Effects. By E. J. Daniels. Pp. 10. Free. (London: International Tin Research and Development Council.) [233

Engineers' Study Group on Economics. Interim Report on the Design of a Family Budget with Special Reference to Food. Pp. 20 (London: Engineers' Study Group on Economics.) 6d. [243

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 1, No. 1: The Lunar Atmospheric Tide at Glasgow. By Prof. S. Chapman. Pp. 5. 6d. Vol. 56, Part 1, No. 2: The Effect of Present Trends in Fertility and Mortality upon the Future Population of Scotland and upon its Age Composition. By Dr. Enid Charles. Pp. 6–12. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [243

### Other Countries

Reprint and Circular Series of the National Research Council. No. 107: Industrial Prospecting. By C. F. Kettering. Pp. 3. (Washington, D.C.: National Research Council.) 25 cents. [233

U.S. Department of the Interior: Geological Survey. Bulletin 858: Zinc and Lead Deposits of Northern Arkansas. By Edwin T. McKnight. Pp. vi+311+11 plates. 1 dollar. Bulletin 868-A: Mineral Industry of Alaska in 1934. By Philip S. Smith. Pp. ii+91+18a. 10 cents. Water-Supply Paper 759: Surface Water Supply of the United States, 1934. Part 4: St. Lawrence River Basin. Pp. vi+159. 20 cents. Water-Supply Paper 762: Surface Water Supply of the United States, 1934. Part 7: Lower Mississippi River Basin. Pp. v+129. 20 cents. Water-Supply Paper 769: Surface Water Supply of the United States, 1934. Part 12: North Pacific Slope Basins. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+165. 20 cents. Water-Supply Paper 771: Floods in the United States: Magnitude and Frequency. By Clarence S. Jarvis and others. Pp. 497+3 plates. 1 dollar. Water-Supply Paper 772: Studies of Relations of Rainfall and Run-Off in the United States. By W. G. Hoyt and others. Pp. 301. 25 cents. (Washington, D.C.: Government Printing Office.) [273

U.S. Department of Agriculture. Circular No. 376: New Equipment for obtaining Host Material for the Mass Production of *Trichogramma minutum*, an Egg Parasite of various Insect Pests. By Herbert Spencer, Luther Brown, Arthur M. Phillips. Pp. 18. (Washington, D.C.: Government Printing Office.) 5 cents. [303

Bulletin of the Vanderbilt Marine Museum. Vol. 6: Scientific Results of the World Cruise of the Yacht *Alva*, 1931, William K. Vanderbilt Commanding. Crustacea: Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. Pp. 264+96 plates. (Huntington, L.I., N.Y.: Vanderbilt Marine Museum.) [303

Records of the Botanical Survey of India. Vol. 8, No. 6: Flora Arabica. By the Rev. E. Blatter. Part 5: Gnetaceae—Gramineae. Pp. ii+451-519+lix. (Delhi: Manager of Publications.) 2 rupees; 3*s*. 6*d*. [303

British Honduras. Report of the Forest Trust for the Period 1st April 1933 to 31st December 1934. Pp. 21. (Belize: Forest Department.) [303

Koninklijk Nederlandsch Meteorologisch Instituut. No. 106a: Ergebnisse Aerologischer Beobachtungen. 23, 1934. Pp. iv+42. 1.50 fl. No. 108: Seismische Registrierungen in De Bilt. 21, 1933. Pp. viii+49. 0.70 fl. ('s-Gravenhage: Rijksuitgeverij.) [303

Canada: Department of Mines: National Museum of Canada. Bulletin No. 77 (Geological Series, No. 52): Hooded Hadrosaurs of the Belly River Series of the Upper Cretaceous, by C. M. Sternberg; Musculature and Functions in the Ceratopsia, by L. S. Russell. Pp. ii+48+7 plates. 25 cents. Bulletin No. 78 (Anthropological Series, No. 17): The Ojibwa Indians of Parry Island, their Social and Religious Life. By Diamond Jenness. Pp. vi+115. 25 cents. (Ottawa: King's Printer.) [303

Canada: Department of Mines: Bureau of Economic Geology: Geological Survey. Memoir 82: A Preliminary Contribution to the Floras of the Whitemud and Ravenscrag Formations. By E. W. Berry. (No. 2397.) Pp. ii+107 (20 plates). 25 cents. Memoir 184: Descriptions of Properties, Slocan Mining Camp, British Columbia. By C. E. Cairnes. (No. 2399.) Pp. v+274+2 plates. 75 cents. Memoir 185: Chibougamau Lake Map-area, Quebec. By J. B. Mawdsley and G. W. H. Norman. (No. 2409.) Pp. iv+95+5 plates. 25 cents. Memoir 186: Gold Deposits of Elbow—Morton Area, Manitoba. By C. H. Stockwell. (No. 2407.) Pp. ii+74. 25 cents. (Ottawa: King's Printer.) [303

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1935. (No. 2402.) Pp. iii+48. (Ottawa: King's Printer.) 25 cents. [303

Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1934. (No. 748.) Pp. ii+202. (Ottawa: King's Printer.) [303

Indian Forest Records (New Series). Vol. 1, No. 1: Shrinkage Studies on Indian Woods. 1: Effect of High Temperatures on the Shrinkage and Moisture Equilibrium of Wood. By Dr. S. N. Kapur and Azizul Rehman. Pp. iv+41. 1.8 rupees; 2*s*. 6*d*. Vol. 1, No. 12: Entomological Investigations on the Spike Disease of Sandal. (26) Coccidae (Homopt.). By N. C. Chatterjee and Dr. Rao Saheb T. V. Ramakrishna Ayyar. Pp. ii+233-242. 7 annas; 9*d*. (Delhi: Manager of Publications.) [303

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No. 34.) Pp. 223-267. (Washington, D.C.: Smithsonian Institution.) [14

National Geographic Society. Contributed Technical Papers, Pueblo Bonito Series, No. 1: Dating Pueblo Bonito and other Ruins of the Southwest. By A. E. Douglass. Pp. 74. (Washington, D.C.: National Geographic Society.) [14

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### Catalogues

Anahæmin B.D.H.: the Active Hæmatopoietic Principle of Ltd.) of Dakin and West. Pp. 14. (London: The British Drug Houses, Liver

A Catalogue of Books published by the Syndics of the Cambridge University Press. Pp. xiv+387. (London: Cambridge University Press.)

A Catalogue of Books on Systematic Botany, Plant Biology, Cryptogamic Botany, including the Library of the late Prof. Otto Vernon Darbishire. (No. 518.) Pp. 40. (London: Bernard Quaritch, Ltd.)

Colloidal Graphite: a Unique Material of Particular Interest to Research Workers. Pp. 23. (London: E. G. Acheson, Ltd.)

Druggists, Surgical and Sundries List. Pp. 12. (Manchester 12: David Moseley and Sons, Ltd.)

British Industries House. Medical Section Annual, 1936. Pp. 104. (London: British Industries House.)

The Hilger Trichromatic Colorimeter. (Publication No. 240.) Pp. 6. (London: Adam Hilger, Ltd.)

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# Science and Progressive National Policy

## The Special Areas and the School Leaving Age

THE second report of the Commissioner for the Special Areas* presented to Parliament in February reviews the progress made during the six months ended December 31, 1935, in the economic development and social improvement of the Special Areas. The policy advocated is essentially a long-term policy, and the Commissioner points out that while many schemes, some of considerable importance, have been sanctioned, the benefits arising from their execution will accrue cumulatively and time will be required before these benefits can be fully secured. Spectacular results are not to be expected but rather a steady improvement, and it would be wrong to judge the value of these schemes solely or even mainly by the amount of employment given. The Special Areas Act does not provide for expenditure on schemes primarily intended to give immediate employment, and no artificial creation of employment has been attempted.

The Commissioner has operated generally through existing authorities, organisation and agencies, and his report, which gives a comprehensive picture of the work so far accomplished, will commend itself to the scientific worker for the width of vision and moderation displayed. Industry in general does not appear to be sufficiently interested in the Special Areas, and there is apparently little prospect of the Special Areas being assisted by the spontaneous action of industrialists now located outside the areas, although inquiry has indicated no well-defined or insurmountable obstacle to the establishment of new industries in the areas.

* Second Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 5090.) Pp. vi+120. (London: H.M. Stationery Office, 1936.) 2s. net.

Measures are required, however, to make the areas more attractive and their economic advantages better known; and some welcome signs of improvement are reported. The necessity for Government action in the financing of new industries in these areas, and also the advisability of extending the preference, other things being equal, given under agreements with the London Passenger Transport Board and the railway companies to manufacture in the Special Areas, is emphasised. Reference is made to the reports submitted by the Newcastle Section of the Society of Chemical Industry and by Armstrong College, Newcastle, on science and industry in the north-eastern area and on the distribution of unemployment in the same area. Specific recommendations regarding the application of science to industry are being considered by the North East Development Board.

Assistance has been given or will be given, subject to the satisfactory outcome of negotiations, to a number of public works of industrial utility, including an afforestation plan proposed to the Forestry Commission which the Chancellor of the Exchequer has since indicated has been accepted in principle and towards which he has agreed to recommend that the annual grant-in-aid to the Forestry Fund should be increased to £500,000 for the next five years.

What is most evident from the report, however, is the necessity of attacking the problem on a wide front by a combination of different methods. The work of the Special Commissioner is severely limited by the narrow official interpretation of the section in the Special Areas Act which restricts his grants to local authorities for "public works for

which no specific grant is payable by any Government Department" and debars him from helping any road or bridge scheme or educational service. The Special Areas, however, cannot be considered apart from the general welfare of the nation as a whole. Their problems will only be solved when they are dealt with from the point of view not of some special area or district but in relation to the resources and needs of the whole community. The greatest need of the Special Areas is that of the whole community—the planning of national resources by creative minds awake to all the possibilities which scientific knowledge and technical skill have put into our hands.

The practical impossibility of dealing with Special Areas alone in any satisfactory way has been ably pointed out by Prof. H. A. Marquand in a recent book*, which indicates the necessity of taking South Wales as a whole, the present 'special area' limits being indefensible. The same unity of the problems of the special areas with the national problems is emphasised in the present report in dealing with such matters as unemployment among young persons. The most serious human problem of the special areas is that presented by unemployment among young men between eighteen and twenty-one years of age. Many of them have done practically no work and, brought up in homes where the father has been continuously out of work, they have little or no conception that a man's ordinary occupation should be such as will provide the means of subsistence for himself and for his family. They have come to accept it as a normal condition for their own families and their friends to be kept for years by the State. In such circumstances, it is not surprising that these young men should be ready victims of all manner of demoralising influences, and they present the most tragic aspect of the problem of the Special Areas, and one fraught with great danger to the State. This problem cannot be ignored by the rest of the community. Great as may be its burden on the Special Areas, it is of manageable dimensions. There are only about 11,000 of these young men, and some 7,000 have been unemployed for more than three months. It calls for urgent and drastic treatment, and none of the recommendations in the report deserve closer attention than those bearing on this question.

In his first report, the Commissioner for the Special Areas recommended raising the age of entry to industry to sixteen years, as an important contributory measure for the reduction of juvenile unemployment. The demoralisation to which reference has just been made emphasises once more the importance of measures which can diminish to any extent this evil, and links up this problem of the special areas with the discussions on the Government proposals for raising the school leaving age which are at present proceeding. It emphasises, in fact, the human and social aspects which have in many such discussions in Parliament and elsewhere been overshadowed by industrial and financial considerations.

The effect of raising the school leaving age to fifteen years on juvenile unemployment throughout the country may well be sufficient by itself to justify taking this step, apart from educational considerations. What is much more important, however, is the reduction of the risk of exposure of the adolescent to periods of recurrent unemployment and its demoralising effects on character. The danger of allowing to grow up within the community a class of young people who have never known the meaning of continuous employment, and who are the ready prey of those dangers to which the Commissioner refers, is far from being appreciated as it should be.

Something more is required than the mere reduction of the risk of unemployment to which these young persons are exposed. An educational and welfare policy must be planned to enable the adolescent to withstand the risks to which he is exposed and to take his or her place as a normal useful and contented member of the community with the capacity and opportunity for expressing his individuality. This need is fully appreciated by the Commissioner for the Special Areas, as is shown in those sections of his report which deal with social service and local amenities, etc. It was equally present in the minds of the Hadow Committee when its report was issued in 1924. Its proposal was not merely the addition of another year to the school life of the child but also the reorganisation of schools into primary and post-primary so as to secure the advantages of a four-year course for senior schools.

Opposition to the Education Bill recently introduced is consistent and widespread from all types of educational authorities, largely because the present proposals of the Government appear to ignore this point. Many experienced administrators have expressed the emphatic opinion that, under the Government scheme, exemptions will be on a

* "South Wales Needs a Plan." By H. A. Marquand. Assisted by Gwynne Meara. Pp. 256. (London: George Allen and Unwin, 1935.) 7s. 6d. net.

scale that makes the promised reform a farce and defeats any real hope of the post-primary schools functioning as they are planned to do. The uniformity with which responsible educational opinion has condemned the Government proposals, the protests of the county councils associations, the summoning of a national conference by the Association of Education Committees indicate the disappointment aroused by this short-sighted step.

In educational policy, as in dealing with the Special Areas, the primary need is some means of planning the whole question in relation to the ultimate needs of the community and its available resources, and then some authority sufficiently powerful to co-ordinate the various interests and factors concerned in action upon the agreed policy, without let or hindrance from sectional interests which at first sight it may appear to affect. The value to the community of the reorganisation in education which the raising of the school leaving age makes possible, whether measured in terms of industrial efficiency or the reduction of juvenile unemployment, is now undisputed.

Apart from its bearing on unemployment, many industries are already prepared for a higher age of entry to industry on the ground of industrial efficiency, and are recruiting accordingly. It should be intolerable that sections of industry or commerce which have been too indolent or incompetent to plan the necessary readjustment should be allowed to prejudice the general interests. Moreover, the effect of the additional year at school in fitting the adolescent to make use of his leisure is a safeguard against the demoralisation referred to by the Commissioner, the value of which is not easily overstressed if the post-primary system outlined in the Hadow report really functions and the last year of school life is something more than the mere waiting or looking for a job.

In education, as in housing, unemployment, nutrition and the depressed areas, much fundamental thinking on the long-range problems involved has already been done. The National Housing Committee has done valuable work towards outlining a national housing policy to deal with the evil of ribbon development and promote a broad master plan including the control of industrial localisation, itself related to the rehabilitation of the Special Areas. Apart from the reports to which reference has already been made, there have been the investigations carried out by the universities in different parts of the country at the request of the Board of Trade. Statisticians have already provided the Ministry of Labour with many of the important relevant facts about unemployment and the labour surplus, as was indicated by M. S. Warrington in a recent paper before the Manchester Statistical Society. The importance of a food policy in relation not merely to agriculture but also to unemployment and health was emphasised recently at a Conference which was arranged by the League of Nations Union, and many of the relevant basic facts have been laid bare by the Committee of the British Medical Association on Nutrition as well as by the Engineers' Study Group on Economics (see NATURE, April 11, p. 627).

What has hitherto been wanting is some sign that such facts and policies are fairly evaluated against the many other claims on the resources and activities of the State. Warmly as Sir Austen Chamberlain's plea for a thinking machine on defence which will not merely co-ordinate the defence forces of the nation but also all the industrial resources at our disposal has been welcomed, we need even more a mind that will co-ordinate not only defence but also all those other policies and factors concerned in the preservation and development of national morale and welfare. Expenditure of, say, £5,000,000 on education and pensions on the lines advocated by Political and Economic Planning last year, or up to £100,000,000 on national food policy as advocated by Sir John Orr, will then be determined less by the financial exigencies of the moment and the demands of other departments of State than by a long-range view of national welfare.

Until we can attain such a position, the utilisation and direction of scientific and industrial research will suffer as have the questions of unemployment and education and the like. Nor can we expect either security or the enjoyment of that higher standard of living which science has undoubtedly placed within our reach, until we can evolve some means of organisation and direction of national policy in which social and scientific factors are evaluated by minds untrammelled by the past and awake to the possibilities of our heritage. Scientific workers cannot wisely evade their responsibility to assist the evolution of such an organisation, in place of the haphazard and often wasteful methods by which in the past we have stumbled along. The control of science itself no less than the welfare of the community depends largely upon the measure in which scientific workers seek to discharge that civic responsibility.

# Animal Variation and Evolution

**The Variation of Animals in Nature**
By G. C. Robson and Dr. O. W. Richards. Pp. xvi + 425 + 2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21s. net.

THE theory of animal evolution is a perennial subject, and such subjects are very often benefited by occasional broad surveys of the knowledge upon which the theoretical conclusions are based. In the book under notice, Mr. Robson and Dr. Richards have set out to reconsider the theory of animal evolution in the light of our present knowledge of variation. Their survey is a broad one. They discuss not only the facts of variation as they are seen in the animal body and its behaviour, but also the genetical background and, on the theoretical side, the truth of the theory of natural selection and of other less widely accepted theories. They tell us that the book has been written with the chief object of providing the zoological systematist with an account of what is known of the biology of the structural differences with which he deals, and with a discussion of the theoretical results of this knowledge; but the book will also be useful to biologists of many other kinds. The facts discussed are biological, and this must be the justification for the present review, which is written from the point of view of the general biologist and not from that of the systematist.

In carrying out their plan, the authors have first given an account of the facts of variation. This, with various related subjects such as the effects of isolation on animal groups and of correlation between variations, occupies the first half of the book. Here there is one somewhat surprising gap in the account of the evidence. Very little space is given to the evidence of palæontological series such as Fenton's brachiopods from the Grand Canyon, the secondary echinoids and the less complete series of tertiary mammals. Such series are mentioned, but there is very little discussion of the nature of the changes, which can be seen in these series to be built up into differences of specific or higher order. Yet, surely, it is only here that we can avoid the difficulties imposed upon us by the narrow time-scale of our modern experience. Such evidence would seem to be particularly valuable for the authors' object. They give us no indication of their reasons for not including an account of this evidence, an account which most readers will anticipate and would have appreciated.

In their discussion of the genetical basis of variation, the authors appear to think that the hereditary variations from which specific differences are built up will be identical in nature with the mutations of genetical experiments. But there is evidence, more especially in plants but also in animals, that species differ in their complex backgrounds of modifying genes as well as in genetic alterations as large and clear-cut as the experimental mutations. If this is true of animal species in general, it would seem to demand a reconsideration of the whole subject. Small mutations in the very numerous genes of the background complex may, under the influence of a changed environment, be much more numerous than the larger mutations. Their effects are likely to be much smaller and more quantitative. Not improbably they would accord much better with the palæontological and other evidence. It is at least clear that, if this view of the genetic differences between species is correct, we shall not be able to argue directly from the properties of large mutations to the problems of specific evolution until we have more knowledge of the frequency and characters of the mutations of these background genes. Here the authors are unfortunate in the time of their publication. This evidence is recent and it could scarcely be expected that it should be considered in a book written, as the authors tell us, three years ago. Nevertheless, it seems to affect the reliability of some of their conclusions.

In the second half of the book, much space is given to discussion of the validity of natural selection as an important factor in the causation of evolution. Throughout, the evidence is considered from a severely critical point of view, an advisable and indeed necessary attitude in view of the very large amount of questionable evidence which is put forward on this and similar subjects. The conclusion is reached that there is some evidence for natural selection as a real factor in the evolutionary process; but the authors do not believe it to play the main part in the causation of evolution. The average reader will probably be surprised by the paucity of the evidence which the authors have been able to collect in favour of natural selection, and by the cogency of their arguments against it. It must be left to each reader to decide whether they have established their case.

Finally, a protest must be raised against the view, which the authors seem to favour, that the genetical character rather than the animal body as a whole is the real unit of zoological systematics. It is true that they admit the unity of the animal organism, but they seem to think this fundamental fact is not of great importance in zoological

systematics. If this is so, systematics must move farther from, and not nearer to, natural history and biology, a result to be deprecated. It is undoubtedly Utopian to hope for a biological treatment of systematics in any near future, but yet it seems clear that the final systematics must be biological, based on the whole life of the animal rather than on the average structure of its adult body. A biologist, at least, may be allowed to hope so.

These criticisms must not be taken to imply that the present is not a valuable book. In it the authors have summarised a vast body of evidence which is not easily obtainable elsewhere, and have discussed this evidence critically. Not all biologists will agree with their conclusions ; but that can be said of most books which are written on so controversial a subject as animal evolution still is.

G. S. C.

# The New Apocalypse of Man the Social Animal

**Human Ecology**

By Dr. J. W. Bews. Pp. xii + 312. (London : Oxford University Press, 1935.) 15*s*. net.

THE advance of science is along two roads : the first is in the direction of greater intensity, particularism and of empiricism, and the second, from intensity, particularism and empiricism, towards extensity, generalisation and synthesis. Explorers along the road of scientific progress carve the challenging hypotheses of former pioneers on milestones which show the truisms from which they then proceed.

"Learning," in the Baconian idiom, "hath his infancy, when it is but beginning and almost childish, then his youth when it is luxuriant and juvenile, then his strength of years when it is solid and reduced, and lastly his old age, when it waxeth dry and exhaust." The childish steps of anthropology, the science of man, were directed by theology and religion, until, barely seventy years ago, it grew to the relative maturity of youth when evolution—Darwin's faith-challenging apocalypse—became the truism of to-day.

By the theory of evolution—which describes the process of adaptation, physical, mental and cultural, to environmental conditions—the study of man is linked in an embracing science to the study of his environment and of his cultural achievements. For while man makes culture, culture conditions man. It is to this synthetic study that Prof. Bews gives the title "Human Ecology". General Smuts in an introduction welcomes this contribution from a plant and animal ecologist as an advance in the methodology of the embracing human science, which is anthropology. Along the paths of extensity and synthesis each new step forward in science is taken when its empirical and morphological ground-work has been achieved. It matters little whether or not we all find any added meaning in the terminology whereby General Smuts lays down that it "is the holistic doctrine which underlies ecology".

The sterile and still surviving controversy between heredity and environment loses all meaning when approached through ecology, as do also many of the anthropological, no less than political, confusions surrounding the words 'race', 'culture' and 'people'. Prof. Bews's work has, therefore, an importance which is scientific, philosophical and, ultimately as have all human sciences, political. His book is also welcome as preparing the way for the new anthropology : "that learning that hath his strength of years, solid and reduced". The author insists, as he must, that anthropology is a department of zoology, and zoology a department of biology ; consequently neither race nor population, unless qualified as human race and human population, can be defined in terms peculiar to anthropology. In a diacritical definition the generic cannot be defined in terms peculiar to the specific. Race is a generic description, the definition of which gives no validity to the assumption that '*a* race' must be pan-diacritic. It is better, in any event, to define 'race' before attempting a definition of 'a race'. The new ethnology is concerned with race-types rather than with races.

From the ecological point of view, there is a functional relationship between organism (man) and environment. If regarded only from the environmental end we are discussing geography. The American group of human geographers, represented by Ellsworth Huntington and Griffith Taylor, is sometimes regarded as the school of pure human ecology. Valuable as are their contributions, they tend to over-emphasise the importance of environment and to distort the 'total situation'. For this and other reasons the reviewer would prefer the name 'ethnogenics' to human ecology ; and Prof. Bews's approach is that of an 'ethnogenist'.

Ethnogenics means the study of human history (and of prehistory) in terms of changing race, population and culture. It describes the ecological approach to anthropology, according to which organism, environment and function are studied as tripartite aspects of essentially indivisible

problems. The ethnogenist, or human ecologist in Prof. Bews's sense, insists on the value of 'function' for survival, and claims that the diffusion of cultural elements by borrowing between races in contact is a process which involves the selection of some elements only, their modification or adaptation to the needs of the borrower and the complete rejection of incompatible elements. Methodologically, Prof. Bews accepts the reviewer's classification of culture by distinguishing the social inheritance of 'culture-forms' and of 'culture-accessories' as well as the genetic inheritance of the 'culture-potential' of their culture-bearers; for at every stage culture is conditioned by the capacity of peoples to give expression to it (chapter vi).

The reviewer does not like the term 'ethnology' used as the equivalent for 'cultural anthropology' (p. 111). Ethnology is a term which should be restricted to the comparative and inductive science by which the races of mankind are compared, identified and distinguished. For the empirical and morphological sciences we have the terms 'ethnography' and 'demography'.

The book is well indexed, and bibliographies are appended to each chapter. In both index and the bibliographies there are, perhaps inevitably, some conspicuous omissions. A few authors who should certainly find a place are omitted, whilst some of us would hesitate to include others who are selected. Some of the authorities included in the bibliographies do not find a place in the general index even when they are mentioned in the text. But these are minor points. Anthropologists, archæologists and others must certainly read Prof. Bews's book. GEORGE PITT-RIVERS.

# Science for All

**More Simple Science:**
Earth and Man. By Prof. E. N. da C. Andrade and Prof. Julian Huxley. Pp. x+352. (Oxford: Basil Blackwell, 1935.) 6*s*. net.

WE think it may be said, without exaggeration, that the average person knows very little about science and usually dislikes having anything to do with it. Frankly it bores him. A few years ago at the annual dinner of a scientific society, a Cabinet Minister, who was one of the guests, began his speech by apologising for his ignorance of science, and added that most of his knowledge of the subject was gleaned from the *Illustrated London News*! One can understand why our rulers often fail to appreciate the value of scientific methods, which often require them to take a long view, when applied to economic Empire development. It may be that much of this ignorance is due to the way men of science present their subject to the unscientific mind. Astronomy has been popularised, but there are many useful branches of science which have not been so treated, anyhow not in suitable language.

It is, therefore, a joy to read the book under review. The language is clear and easy, while there is behind every statement the weight of undeniable authority. Would that more men of science would take the trouble to do for the man-in-the-street what Profs. Andrade and Huxley have done. This volume, mainly by Prof. Julian Huxley, forms part of a series of separate books adapted for schools, which the joint authors are undertaking, and is a continuation of, and complementary to, a previous volume entitled "Simple Science". The opening words of the first chapter describe its objects: "In this Book we shall deal with some of the rules about living things in their relation to the planet Earth which serves as their home, ending up with some facts concerning man in his relation to the earth and to other living creatures." Following on these lines there are chapters on the climates of the earth; simple statements on geological structure; the chemistry of life, dealing with various cycles in the circulation of matter through life including an interesting section on the wastefulness of man; how soil is formed and the different kinds there are; plant food and fertilisers, plant life and scenery; the stream of life, the life story of an animal and its development; animals and plants can change, and the deliberate improvement of living creatures.

The last two chapters are devoted to a sketch of the history of science through the ages, and how science has changed general ideas. "Science means finding out how things actually *do* happen, not laying down principles as to how they *ought* to happen."

As we have quoted the beginning of the volume we may now appropriately quote the end: "Without science and the scientific spirit, we shall just drift along; with their aid, man may be able to learn to control his destiny." The illustrations, by L. R. Brightwell and Comerford Watson, are cleverly done and suit their purpose admirably.

As part of the acquisition of a useful general knowledge of science in schools, we could not recommend a better book than this. H. L. C.

**Reports of the Progress of Applied Chemistry**
Issued by the Society of Chemical Industry. Vol. 20, 1935. Pp. 819. (London: Society of Chemical Industry, 1936.) 12*s.* 6*d.* (to members, 7*s.* 6*d.*).

To maintain a really adequate private library is unfortunately beyond the means of many chemists, who depend for their guidance to progress in their science on a carefully selected collection of monographs, summaries and abstracts. Among those signposts none is better known or more appreciated than this series of annual publications which, together with the series of reports on pure chemistry published by the Chemical Society, afford a very comprehensive survey extending to some of the farthest boundaries of the field. The success of such a survey depends in no small measure on the degree to which the contributors, forty-two in number, succeed in presenting a connected story rather than a mere collection of relevant abstracts, and there is evidence of considerable attention having been paid to this fact. On the other hand, a report is not an essay, and it is the business of the reporter to give chapter and verse for his statements, so that the harvest of references to original papers and their abstracts is as rich as ever.

The elimination of the report on explosives (which is dealt with every alternate year) has not appreciably diminished the size of the book, which comprises twenty-five reports on as many sections of applied chemistry under the editorship of Mr. T. F. Burton, editor of *British Chemical Abstracts* and of the *Transactions of the Society of Chemical Industry*. New reporters are Dr. D. Burton on leather and glue, Mr. W. A. Damon on acids, alkalis, salts, etc., Mr. C. Jepson on sanitation and water purification, and Messrs. H. A. Turner and W. F. A. Ermen on bleaching, dyeing, printing and finishing. To those also whose interest in applied chemistry is secondary to that in some other branch of learning this report can be recommended as a trustworthy guide. A. A. E.

**Chronic Nasal Sinusitis and its Relation to Mental Disorder:**
an Applied Pathology of Abnormal Conditions of the Nasal Sinuses found in Mental Hospital Patients. By F. A. Pickworth. Pp. xii + 156 + 5 plates. (London: H. K. Lewis and Co., Ltd., 1935.) 16*s.* net.

As a presentation of the relation of sinusitis to the occurrence of mental disorder, this book is not convincing. If the author would only give us reliable control figures we might listen, but until we know what proportion of patients in general hospitals have sinusitis, as judged by the same standards, we shall not be convinced. We take serious objection to the statement that "Hysteria should be treated as a medical disease due to minute focal brain lesions, and not due solely to the imagination". The prevalence of agglutinins to organisms of the typhoid-dysentery-foodpoisoning group amongst mental hospital admissions probably corresponds to their occurrence amongst the general population of a large city like Birmingham. The percentage in admissions from rural areas is very small.

**Mules and Men**
By Zora Neale Hurston. Pp. 343. (London: Kegan Paul and Co., Ltd., 1936.) 12*s.* 6*d.* net.

WHILE the reader of this book may not feel constrained to endorse fully the publisher's exuberant statement that it is the most wonderful collection of folk-lore in the world, it will be admitted that it is a remarkable production, which gives an illuminating view of negro society in the southern United States. The book, indeed, is noteworthy because it is a record of negro mentality by one of themselves, who is also a trained anthropologist. Miss Hurston, who is a pupil of Prof. Franz Boas of Columbia University, after graduation elected to take up negro folk-lore as a subject of research, and chose her own home town in Florida as the starting point of her investigation. The narrative of her experiences in search of material is rich in vivid detail and characteristic touches, interspersed with sermons, songs, music and stories, in which humour, religion and unconscious irreverence are closely interwoven.

In the second part of her book Miss Hurston records her further experience when seeking initiation into the mysteries of voodoo in New Orleans. She became the acolyte or associate of a number of the leading exponents of this form of magical belief, some of whom claimed to be relatives of, or to have been associated with, the notorious Marie Leveau, well known as a voodoo priestess in New Orleans at the close of the last century. Miss Hurston has made an interesting record of her various initiations, which will be of value to students of this ritual. A note of the author's own emotional reactions would have been of considerable interest.

**Lake Tana and the Blue Nile:**
an Abyssinian Quest. By Major R. E. Cheesman. Pp. xiv + 400 + 25 plates. (London: Macmillan and Co., Ltd., 1936.) 18*s.* net.

WHEN Major Cheesman entered upon his duties as H.B.M. Consul in north-west Abyssinia, he found that no large-scale maps of the Abyssinian portion of the Blue Nile were available. He was also informed that the course of the Blue Nile was the only part of Africa remaining which offered opportunity for pioneer exploration. During his nine years' residence in the country, he took full advantage of the opportunity and of the permission given him to explore. In this volume he gives his readers a record of his journeys. Not only is his account of special interest at the moment, but it is also of permanent scientific value as the story of the first visit of a European to the islands of Lake Tana and of the first journey to be made down the Nile through unexplored country to the point reached by previous explorers, who had entered Abyssinia by way of the Sudan.

Major Cheesman, already well known to students of geographical literature as a traveller in unexplored parts of Arabia, has made a notable addition to recent work dealing with a country but little known until the march of events brought it into the limelight. The narrative is illustrated by a series of excellent and illuminating photographs.

**Physiology in Modern Medicine**
By Prof. J. J. R. Macleod, assisted in the present edition by Prof. Philip Bard, Prof. Edward P. Carter, Prof. J. M. D. Olmsted, J. M. Peterson, Prof. N. B. Taylor. Seventh edition. Pp. xxxii + 1154 + 7 plates. (London: Henry Kimpton, 1935.) 36*s*. net.

WE are fortunate in acquiring a new edition of this standard book on physiology since it turned out to be the last work of Prof. Macleod. During his extensive investigations, he made substantial contributions to the science of physiology especially on carbohydrates, while during his many years of teaching medical students in Great Britain and in Canada he established many friends in both continents. This explains the multiple authorship of the book and the guiding principles underlying its general design: Prof. Macleod here presents physiological principles on a strict physico-chemical basis. He has even gone further and has brought the phenomena of several diseased conditions to the same scientific basis.

It is this single purpose, which applies to the working of disabled as well as normal organs, which makes reading pleasant and ensures that the thousand pages are none too many. Some of the early chapters are expressly devoted to purely physical considerations, so that the reader can be sure of following the more applied sections of the book.

For the medical student who wants a scientific text-book of physiology and for the practitioner who wants to establish his everyday practice gained by experience on a scientific basis, this book will be found useful. It is one of the best books available which combines the modern science of physiology with the old art of medicine.

**Factor Analysis in the Study of Personality**
By John Clemans Flanagan. Pp. x + 103. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1935.) 6*s*. net.

THIS monograph gives a clear account of the development of the statistical techniques that have been devised to analyse the multiple factors involved in tests and ratings, and in particular in those that are employed in personality study.

Beginning with Spearman's two-factor theory, the adequacy of which to deal with the simple case of hierarchical correlations is admitted as "firmly established", the author points out that this theory is inadequate to deal with complex factor patterns, in respect of which the work of Kelley, Thurstone and Hotelling is examined. The aim of all such techniques is to discover the basic independent factors which enter into functional synthesis and appear as abilities. These factors are 'indicated' rather than defined by the statistical procedures; and it remains to construct mental tests which will emphasise the factors individually in such a manner as to allow of the determination of their nature.

Factor analysis is rapidly coming to the fore in psychological work; and this monograph will be studied with profit by those who wish for a concise introduction to it.

**Garden Science**
By Dr. John Grainger. Pp. ii + 265. (London: University of London Press, Ltd., 1935.) 4*s*. 6*d*. net.

IN this small volume a considerable amount of information concerning the fundamental principles underlying the practice of horticulture is compressed. It consists of eight chapters, the first three of which deal with physiology as concerned especially with the raising and growing of plants. The fourth chapter, dealing with vegetative propagation, grafting, pruning and the like, is of value to gardeners since it contains scientific information on subjects often ignored in text-books. The last three chapters deal with diseases (fungus and virus) and insect pests: they cover a wider range than might be expected in so small a volume (though T.S.W. virus is not mentioned), and many readers might prefer a fuller treatment of fewer subjects.

The section dealing with the flowers and the exposition of Mendelism is good, but the differentiation of the mechanisms which insure cross-pollination and those which prevent self-pollination is not very clearly defined. In the plant disease chapters the long-abandoned name *Synchitrium* [*sic*] *solani* is employed instead of *Synchytrium endobioticum* now in general use, whilst an error has obviously crept into Fig. 32. The book will be decidedly useful for purposes of horticultural training in schools and colleges.

**Tissue Culture:**
the Growth and Differentiation of Normal Tissues in Artificial Media. By E. N. Willmer. (Methuen's Monographs on Biological Subjects.) Pp. viii + 126 + 2 plates. (London: Methuen and Co., Ltd., 1935.) 4*s*. net.

THIS brief account of the technique and results of the culture of tissues *in vitro* is to be commended to senior students of the biological subjects, as it presents the state of knowledge both of the growth and differentiation of the cell as well as a clear description of the role of the nutrient medium. The physiology of unorganised growth in epithelia and connective tissue is discussed with the same clarity as the organisation of embryonic tissues grown in cultures. The author is to be complimented on the avoidance of technical terms. A glossary, comprehensible even to the layman, is included.

**Tropical Planting and Gardening:**
with Special Reference to Ceylon. By H. F. Macmillan. Fourth edition. Pp. x + 560. (London: Macmillan and Co., Ltd., 1935.) 25*s*. net.

IN Ceylon, cultivation, whether for profit or pleasure, is conducted under very varied conditions due to the great range of both altitude and rainfall. A comprehensive account of what is possible there is thus of great utility to residents in many parts of the tropics and sub-tropics. This work, now in its fourth edition, thoroughly revised and enlarged is, even more than its predecessors, an indispensable book of reference for all planters and gardeners in tropical countries, its value being enhanced by its wealth of illustrations and very full index.

# The Total Solar Eclipse of June 19

THE coming total solar eclipse should be very fully observed if the meteorological conditions are favourable.

Prof. Horn d'Arturo hopes to secure a photograph of the corona in Greece just after sunrise, while snapshots of the corona may also be obtained by some of those on a P. and O. Mediterranean cruise who will be off the Greek coast on the morning of the eclipse. Comparison of these photographs with any secured in Hokkaido will show what changes have taken place in the form of the corona during an interval of 2·5 hours. Between these extreme stations there will be a large number of expeditions.

Dr. Donitch, of the Starya-Doubossary Observatory of Rumania, accompanied probably by Dr. R. L. Waterfield, will observe the eclipse from the north coast of Asia Minor, where the weather prospects are favourable. Dr. Donitch will study especially the chromosphere with slit spectrographs and objective prism spectrographs, and the corona with a spectrograph of low dispersion and with cameras of short focal-length, while Dr. Waterfield will photograph the corona through a number of filters, with special attention to the infra-red. Two Russian parties from the Abarzumian and Kharkov Observatories will be stationed in the Caucasus, where also a party from Czechoslovakia under Dr. Slouka will be stationed, and also possibly an expedition from Italy consisting of Prof. Abetti and Dr. Righini and equipped mainly with spectrographic apparatus. The last-named party may, however, be going to Japan.

Numerous Russian parties will be distributed along the eclipse track across Siberia. In the lower Volga area there will be an expedition from the Moscow Observatory and a smaller one from the Moscow Astronomical Society; at Kustanaj an expedition for the spectrophotometry of the chromosphere and the photometry of the corona from the Engelhardt Observatory; near Orenburg an expedition from the Pulkovo Observatory—the spectrum of the chromosphere will be obtained in the extreme ultra-violet with a quartz spectrograph and also in the infra-red, while the microstructure of the chromosphere will be examined with a prismatic camera. The second expedition from the Pulkovo Observatory will go somewhere near Omsk, where the corona will be photographed with two or three Ross lenses and with two spectrographs; the programme will include some spectrophotometry and the study of polarisation phenomena. At Kansk and Tomsk there will be expeditions from the Leningrad Institute; at Krasnoyarsk a further party from Moscow; at Bratsk another party from Leningrad under Prof. Noumerov; an additional party from Moscow at Alexandrovsk will examine the Einstein effect, while one of a series of six similar coronagraphs will be installed at Khabarovsk. In addition to preparing their own equipment for the eclipse, the Russian astronomers have placed their colleagues under a heavy debt by much spade work in the study of the meteorological and other conditions along the eclipse belt.

Other parties visiting the territories of the U.S.S.R. include three American and one British party. The expedition from Harvard University and the Massachusetts Institute of Technology—Dr. D. H. Menzel, Dr. J. C. Boyce and Mr. E. A. Benfield—will be at Ak-Bulak near Orenburg. They will use two 21-ft. concave gratings with moving plates and some grating spectrographs for a series of intermittent exposures on stationary films, also several prism spectrographs. Both the chromosphere and the corona will be examined. This party will be joined by Prof. W. R. Brode of the Ohio State University with a 3-m. concave grating and moving plate camera for the chromosphere.

The third party from the U.S.A. will be under Dr. P. A. McNally, *S.J.*, and will be organised by the Georgetown College Observatory and the National Geographic Society. It will be stationed at Sara and occupied mainly with direct photography of the corona.

The British party under Prof. J. A. Carroll, of the University of Aberdeen, will be at Omsk. Other members of the party will be Mr. E. G. Williams, of the Solar Physics Observatory, Cambridge, and Major Luck. With an objective interferometer, the widths and detailed structure of the chromospheric lines will be studied and also the internal motions in the corona. An attempt will be made to secure fresh lines in the infra-red in the coronal spectrum.

The other expedition under the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society is proceeding from the Solar Physics Observatory, Cambridge, to Kamishari in Hokkaido. The members of the party are Prof. F. J. M. Stratton, Dr. R. O. Redman and Dr. F. W. Aston of Cambridge, Dr. T. Royds, director of the Kodaikanal Observatory in South India, Dr. C. W. Allen, of Mt. Stromlo Observatory, Mr. A. D. Thackeray, of Cambridge (from Mt. Wilson Observatory), and Major R. A. Bagnold,

Royal Signals. It is hoped that Dr. C. D. Stewart of Singapore, Dr. Jeffreys from Hong-Kong and one or two others stationed in the Far East may get short leave and join this party.

The programme includes spectrophotometry of the chromosphere by means of a series of short exposures on a moving plate held fixed for each exposure, a study of the extreme ultra-violet spectrum of the chromosphere and corona with a quartz spectrograph fed by aluminised mirrors in place of mirrors of speculum metal, a study of high-dispersion spectrograms of the limb near totality and of the chromosphere for accurate wavelengths, an examination with Nicol prisms and Savart prisms of the polarisation of the corona and of the surrounding regions of the sky, a study of the Fraunhofer lines in the spectrum of the outer corona and direct photography of the corona in the ultra-violet, photographic and infra-red regions.

If, as was not definitely known at the time of writing, Dr. Johnson of the California Institute of Technology comes to Japan, he will continue the investigations on the polarisation of the corona, which he carried out at the last eclipse.

Finally, we come to the list of Japanese expeditions, and here tribute must be paid to the Eclipse Committee of the Japanese National Research Council for the many steps taken to help the visiting observers. From the Tokyo Astronomical Observatory and the National Science Laboratory at Shanghai a party will proceed to Manchukuo to observe the eclipse from a station near the frontier. Director Sotome and other members of the staff of the Tokyo Astronomical Observatory will form three parties observing at Nakatonbetu, Abashiri and Monbetu: they will take photographs of the eclipse star field for the Einstein effect, and also take direct photographs of the corona. Prof. T. Tanaka, of the Physics Department of the Tokyo Imperial University, will examine the spectrum of the corona from the Mitsui Agricultural Farm near Syari; Director Okada and Dr. Sekiguti, of the Central Meteorological Observatory, will arrange observations of the eclipse from aeroplanes at Nemañbetu; Prof. Ono, of the Tokyo Bunrika University, will take observations of terrestrial magnetism, while Prof. S. Nakamura, of the Tôhoku Imperial University, will study earth currents and other geophysical phenomena at Kosimizu; Prof. Matukuma, of the same university, will carry out further astronomical investigations, as also will Prof. Ueda and Prof. I. Yamamoto, of the Kyoto Imperial University.

No wide region of the eclipse track will be without its party of observers, and by general agreement, for the most part reached at the Paris meeting of the International Astronomical Union last year, the most important observations, where duplicated, are being made at well-separated stations. A reasonable amount of luck should secure from the successful parties a well-balanced body of fresh knowledge as to the upper layers of the solar atmosphere. F. J. M. S.

# Late Cenozoic History in India

By Dr. Hellmut de Terra, Research Associate in Geology, Carnegie Institution of Washington and Yale University

THE progress recently made in the prehistory and geology of man in China, Java and Africa called for an organised study of the late Cenozoic history in India, the importance of which as a promising research field had been previously recognised by men of science such as Pilgrim, Merriam and Hrdlička. The approach to this complex task was determined by geological considerations, inasmuch as the stratigraphy of the Pliocene–Pleistocene sequence had to take account of the young Himalayan mountain uplifts and related phenomena. Two previous expeditions of mine had given me an intimate knowledge of the geology in north-west India, and therefore I chose for my studies a stretch of country extending from the Kashmir valley across the Pir Panjal range and Poonch to the Salt Range between the Rivers Indus and Jhelum. This sector comprises the slope of the main Himalaya and the adjoining plains in the Punjab with their more recently uplifted ridges.

The field work was carried out last year in association with Dr. Teilhard de Chardin who joined the expedition for the last three months, and with T. T. Paterson of the University of Cambridge. N. K. N. Aiyengar, of the Geological Survey of India, was in charge of the collecting of fossils, and D. Sen of the University of Calcutta acted as field assistant. Temporary associates of my party were H. J. H. Drummond and P. Krishnaswami.

The Pliocene formations, to which we also refer the Chinji-beds with *Hipparion* fauna, offered, as on my previous expedition in 1932, an opportunity

of gathering additional fossil material, particularly of the higher primate group, of which some new genera had recently been described. Last year, twenty-five primate remains were collected, consisting of two jaws, a few maxilla and mandible fragments and isolated teeth. These fossils will be worked out by Prof. W. K. Gregory, who believes that their study will add substantially to our still meagre knowledge on the evolutionary trends among the man-like apes of late Tertiary time.

glaciation, which Dainelli once referred to the Mindel advance in the Alps.

An important observation of ours was the merging of the 'Boulder Conglomerate' fans into ground moraines derived from the second ice advance. At Campbellpore, near the Indus, the Boulder Conglomerate carries erratic blocks and it overlies unconformably tilted fossiliferous early Pleistocene beds. In Kashmir also the older Pleistocene lake beds are folded and in Jammu

TABLE SHOWING THE LATE CENOZOIC SEQUENCE IN NORTH-WEST INDIA

| Period | | Stage | Fauna | Glacial cycle in Kashmir | Prehistoric culture |
|---|---|---|---|---|---|
| Pleistocene | Upper | Redeposited silt | | 4th ice advance. T.M. 8,000 to 10,000 ft. | ? Upper Palæolithic |
| | | Erosion | | 3rd interglacial erosion | |
| | Middle | *Potwar*: yellow, loess-like silt, and gravel | Narbadda fauna in 'upper group' | 3rd ice advance; 3–4 recessional moraines. T.M. 6,500 ft. | Soan culture in lower gravel and in silt |
| | | Erosion | | Long 2nd Interglacial: Upper Karewa beds erosion | Lower Palæolithic Soan culture |
| | Lower | *Boulder Conglomerate* | Narbadda fauna in Central India. *Equus*, *Bubalus*, *Hippopotamus*, *Elephas namadicus* | 2nd ice advance; boulder clay and gravel in Karewa beds | In Punjab: worn flakes. In Narbadda valley: Chelleo-Acheulean; ? early Soan |
| | | *Pinjaur* | *Equus*, *El. namadicus*, *Bos*, *Sus*, *Rhinoceros*, *Cervus*, *Felis*, *Sivatherium* | 1st interglacial; Lower Karewa beds, birch, oak, pine-forest | ? |
| | | *Tatrot* | *Stegodon bombifrons*, *Hippohyus*, *Hexaprotodon*, *Pentalophodon falc.* | 1st ice advance. T.M. 5,500 ft. | |
| Pliocene | | *Dhok Pathan* | *Hipparion*, *Tragocerus*, *Stegolophodon*, *Bramatherium* | | |

(T.M.—elevation of terminal moraine walls above sea-level. Broken lines—main unconformities.)

So far as our results on the Pleistocene succession in north-west India are concerned, they are briefly summarised in the accompanying table. This tabulated statement, however, should not be regarded as the ultimate résumé of my views, gained through field studies and clarified through repeated discussions with Dr. Teilhard and with Mr. Paterson. It may be seen that the Upper Siwalik stages, such as Tatrot, Pinjaur and Boulder Conglomerate (terms by Dr. Pilgrim) could be linked with the glacial cycle in Kashmir. Paterson and I surveyed and partly mapped the Pleistocene in Kashmir, and our views principally uphold Dainelli's theory of a fourfold Himalayan glaciation. However, we seem to differ from his views as regards the relative age of the first

overthrust movements are clearly recorded from this period. A second major phase of diastrophism occurred during the second interglacial, and a third, but lesser one, after the third ice advance. We noticed a regional presence of five terraces in the valleys of Kashmir and of the plains which are clearly linked with the last two major glaciations and interglacial periods, and a minor late-glacial ice-advance.

The prehistoric cultures found in this area range from Early Palæolithic to Late Middle Palæolithic and Neolithic. The oldest is represented by worn flakes in the Boulder Conglomerate and by bi-faces, cleavers and hand-axes associated with gravels of perhaps similar age. The Soan culture, named after the Soan River near Rawalpindi, is

mainly a flake culture of distinct facies which may range from the Early to late Middle or even Upper Palæolithic. Workshops belonging to this Soan industry are numerous below the Potwar loess-like silt.

During the last two months, various excursions were made to Upper Sind, Central and Southern India. Along the Narbadda River, Dr. Teilhard and I collected Chellean and Acheulean tools from beds containing the Narbadda fauna of Middle Pleistocene age. Here also were found artefacts belonging to the Soan culture.

Paterson, Drummond and Krishnaswami studied the prehistoric collections in the museums at Lahore, Benares, Calcutta, Madras, Trivandrum, Colombo and Bombay, and field work was carried out by them in Madras and Bombay presidencies. They reported a widespread occurrence of the Soan culture, of a microlithic industry, and of a proto-Neolithic culture. The early Neolithic in these collections appeared to be akin to that of northern Europe, though there occur types similar to the latest Upper Palæolithic of North Africa.

The artefact collection, numbering more than four thousand specimens, will be worked out by Paterson and Drummond at the Archæological Museum of the University of Cambridge.

The researches were made possible through the support of the Carnegie Institution of Washington, the American Philosophical Society, the Royal Society of London and the University of Cambridge. The co-operative policy of the Government of India and of the Geological and Archæological Surveys of India is gratefully acknowledged.

# Food from Wood

THE suggestion has recently been made that as much food might be obtained per acre of woodland as per acre of arable land, if the wood be so treated as to yield sugar. The production of sugar from wood has been a subject of much research, especially in Germany and the United States. There is no doubt that it can be achieved, not only on a small laboratory scale but also in commercial plant operation; the difficulties that have had to be overcome have been those of chemical engineering rather than of chemical reactions. There is, however, a very real doubt whether such a process is justifiable, save perhaps in time of national emergency (for which purpose it was developed in Germany during the Great War), or whether it can ever be economically a sound proposition.

From a material point of view, timber is grown for two main purposes—either for use as a structural material or for its cellulose content. There are perhaps few structural uses of timber that could not be satisfied by other materials. Cellulose, however, is as yet quite indispensable, not merely as pulp and paper, but also in its myriad new uses for textiles or rayon, lacquers, cellophane, etc. To split up such a valuable raw material to sugar is certainly unsound from the point of view of the proper utilisation of natural resources, and only justifiable if the products cannot be obtained from any other source. The agriculturist will answer that sugar of a purer and more usable type may be obtained directly from sugar beet, or from cane, or can be obtained far more simply from starchy crops such as potatoes or maize. Sugar beet is capable of yielding 2–3 tons of sugar per acre, and sugar cane 4–5½ tons per acre. The starch in potatoes amounts to 1½–2 tons per acre, or in maize, 1 ton per acre, equivalent to an almost equal weight of sugar.

To make a comparison of these yields with those possible from woodland is difficult, inasmuch as the latter is obviously not an annual crop. The faster growing soft woods (conifers) may be said to give more than 300 tons of timber per acre per 100 years, or 3 tons per acre per year. The maximum yield of wood sugar so far claimed is two thirds of the weight of the wood, or 2 tons per acre on an annual basis. This calculation is rather questionable because the annual rate of increase of saplings is much greater for the first ten to twenty years than at maturity, and the yield of wood sugar per acre obtainable from young growth might be at a higher level. Against this must be set the fact that the rate of growth of most woods is considerably below that of the very vigorous soft woods such as silver fir.

The most serious objection that can be raised to the process, however, is the nature of the sugar produced. Whereas cane and beet give almost exclusively sucrose, that from wood is a mixture of several sugars, not all of them of equal value as food to man or animals, or even of equal availability for biological fermentations. The chief constituents of woods are cellulose, hemicelluloses and lignin. The proportions found usually lie within the following percentage limits—cellulose, 50–60, hemicelluloses, 10–15, lignin, 20–30. The cellulose of woods is not identical with the standard cellulose of cotton, but contains considerable amounts of the pentosan—xylan—particularly in the case of

hard woods, in which as much as 25 per cent of the wood cellulose may be xylan. Softwood cellulose contains less xylan but has in addition mannan. The hemicelluloses are carbohydrates built up from a number of sugars, such as galactose, arabinose, mannose and xylose, and may easily be split up into these components. Wood sugar is a mixture of all these sugars with glucose from the true cellulose, and even if complete breakdown of the wood is effected, the sugar mixture obtained may not contain more than 60 per cent glucose. It is important to keep this fact in mind when considering the possible uses of wood sugar.

Much of the work on the saccharification of wood has been directed to the production of alcohol from the product by fermentation. Of the sugars present only glucose and mannose are fermentable by ordinary yeasts, the pentose sugars and galactose remaining behind. Since the yield of alcohol from a fermentable sugar is less than 50 per cent, the amount of alcohol to be obtained from wood is not great. Yields of 25–30 gallons of alcohol per ton of sawdust have been obtained commercially, and higher amounts in laboratory scale experiments. The pentose sugars unattacked by the yeast may afterwards be fermented with special bacteria to give largely lactic acid and a little acetic acid. High yields of acids may alternatively be obtained by direct fermentation with such organisms as produce lactic acid from both hexoses and pentoses.

For use as food or as a raw material in the production of food, wood sugar may be employed in several ways. It may be fed directly as cattle food and has been said to have practically the same nutritive value as barley flour. The availability of the pentose sugars in the mixture is, however, a matter of doubt; xylose is little utilised by animals or man. The food value probably lies therefore in the glucose and mannose present. Alternatively, the glucose may be separated out in a pure condition and used in other foods. Glycerol might be obtained by modified yeast fermentations in the presence of sulphite, which results in a yield of 15–20 per cent of the sugar fermented, or protein obtained by using the wood sugar solution as a nutrient for yeasts or fungi under such conditions as result in the production of maximum yields of microbial tissue.

The actual production of wood sugar may be achieved in two ways. The complex carbohydrates of the wood may be split up either by dilute acids at high temperatures and pressures or by concentrated acids at ordinary temperatures. The latter procedure, which is the basis of the Bergius process, operated in Germany, gives both higher yields of sugar and higher percentages of fermentable sugar than the former. Unless the treatment is prolonged and the temperature high, dilute acids do not break down the true cellulose completely. Degradation products of the sugars, such as furfural and humus substances, are also formed. Concentrated acids, on the other hand, result in complete solution of the wood, leaving only the lignin behind. The wood in the form of chips is treated with 7 parts of 40 per cent hydrochloric acid in a continuously operated battery of 8–10 vessels. The acid is removed from the extract by vacuum distillation to give a product containing 60 per cent sugar and 8 per cent hydrochloric acid. An atomising drier concentrates this to 90 per cent sugar content with only 1 per cent hydrochloric acid.

The engineering difficulties in the recovery of the acid without damage to the product have been very great, but it is now claimed that the total acid loss is not more than 10 per cent calculated on the sugar obtained. The yield of sugar from a coniferous wood is 66 per cent, which approaches the theoretical. Although the action of the strong acid results in such an extensive breakdown, the true cellulose fraction is not completely split up to glucose but remains in the form of cellulose dextrins, which consist of cellulosic fragments each built up of a few glucose units. These are not fermentable, and to obtain the glucose from them an aqueous solution must be boiled with dilute acid for a short time. The wood sugar mixture then obtained may be separated or utilised in one of the ways mentioned above.

In normal circumstances, the commercial production of wood sugar, though a remarkable feat in chemical engineering, cannot be taken as any threat to agriculture in view of the heterogeneous nature of the product obtained, and the growing world shortage of timber for pulp. Claims have been made that in the most favourable situation and conditions glucose might be obtained from this source more cheaply than sucrose from sugar beet. Ordinarily, however, there must be a wide disparity in costs, and sugar beet cultivation has the advantage additionally of giving much employment. One development which might make the wood sugar process economically possible in normal times would be a demand for lignin for some manufacturing purpose. At present the residual portion of the wood, consisting almost exclusively of lignin, remains unutilised. This amounts to 20–30 per cent of the weight taken. The possibilities of lignin as a raw material in industry have not been adequately considered, perhaps because the constitution is still obscure. Because of its marked resistance to biological attack, and inertness to strong chemicals, other than oxidising agents, it should find a useful outlet. The production of wood sugar and lignin from wood would then be more defensible than that of sugar alone.

A. G. N.

# Coal Hydrogenation in Great Britain

THE daily discussion of 'oil sanctions' will have served a useful purpose if it brings home to the public the perilous position of Great Britain in regard to oil supplies in time of war. Actually the London omnibuses alone consume more fuel than the total quantity of benzole produced by coke ovens and gas works, whilst apart from the new coal hydrogenation plant of Imperial Chemical Industries at Billingham, the total production of home-produced fuel is less than 7 per cent of British requirements. Germany is paying great attention to this same problem of producing oil internally and is already in a much more favourable position than Great Britain.

The main achievement in England so far is the hydrogenation of hard coal by a process, discovered by Bergius, developed by Imperial Chemical Industries, Ltd., as a member of the International Hydrogenation Patents Co., and brought into highly successful operation on a large scale at Billingham during last winter. The story of the achievement has been told in a paper read by Kenneth Gordon before the Institute of Fuel; it has been supplemented recently by a technical paper issued by the Fuel Research Board* describing the earlier investigations of Bergius and the action of the Department, and its connexion with other bodies interested in the subject prior to the advent of I.C.I. This forms a valuable historical survey.

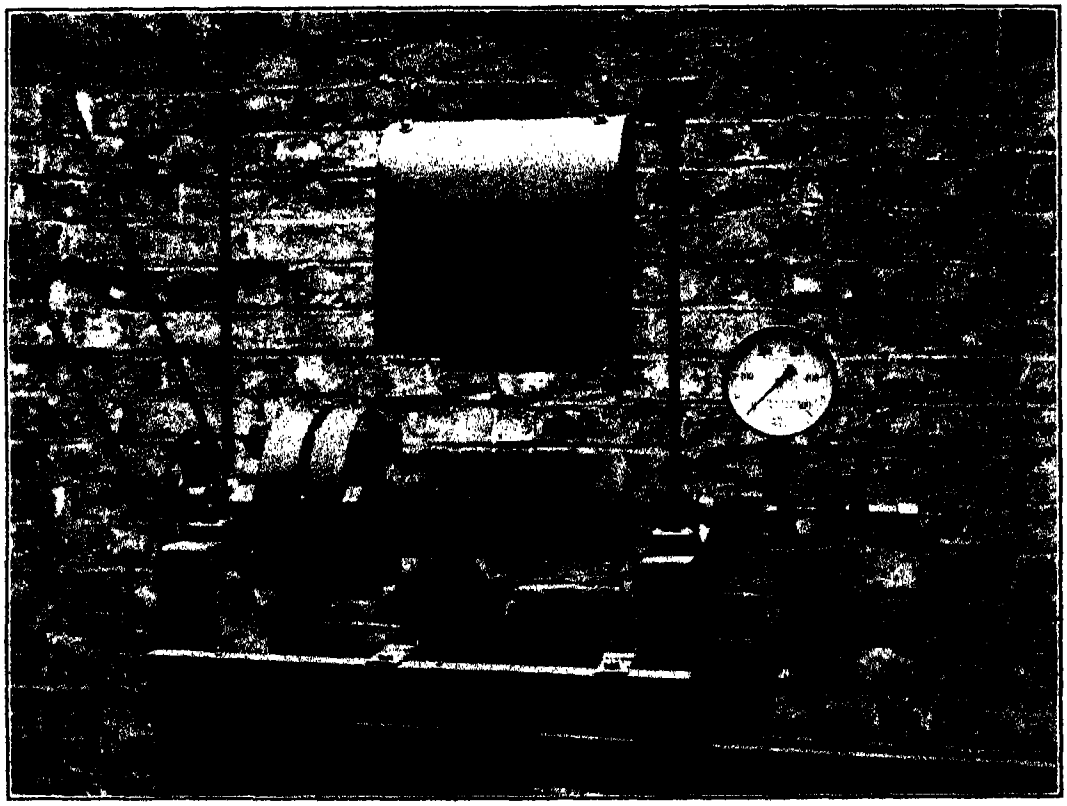

FIG. 1. Bergius 2-litre converter. From Fuel Research Technical Paper No. 42. Crown copyright reserved.

The earlier work of Bergius is now well known to those interested: it took him some time to reach the stage of the two-litre converter illustrated here (Fig. 1). Fig. 2, showing a single hydrogenation stall or unit at Billingham, indicates the growth of the process on the engineering side, though its practical development is due also to certain chemical discoveries, notably the favourable influence of adding hydrogen chloride during hydrogenation and its subsequent removal with a stable suspension of alkali in oil from the hot vapours.

* Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 42: The Action of Hydrogen upon Coal. Part 2: Early Experiments with the Bergius Process. By Dr. L. Horton, Dr. F. A. Williams and Dr. J. G. King. Pp. vi+58+9 plates. (Adastral House, Kingsway, London, W.C.2: H.M. Stationery Office, 1935.) 1s. 3d. net.

At a time when the Bergius experiments at Mannheim-Rheinau were languishing, they were revivified by the British Bergius Syndicate, formed largely by the efforts of Dr. Ormandy, which had for its object the proving of the process with British coals. After a time it was decided by the Government that the Department of Scientific and Industrial Research should proceed with the investigations, and towards the end of 1926, a plant embodying the latest improvements resulting from the work at Rheinau was installed at Greenwich, the small-scale experiments in Rheinau being terminated. The British Bergius Syndicate was acquired by I.C.I. in 1927, which started independent research at Billingham on a rapidly growing scale, so that by the end of 1933 the cost had amounted to approximately £1,000,000 : this is the outstanding example of the complexity and the high cost of working out a new chemical process to the point of industrial practicability. Such a cost makes it difficult for any one other than a large and prosperous company, or an association backed by ample Government support, to investigate new processes. The 'City', though apparently prepared to spend large sums to prove and develop a potential gold mine, will not support as a rule the development of elaborate industrial processes, though it is willing to buy them from abroad when developed. As a consequence, England is perforce content to lag behind in such developments, for which the credit is too often given to foreign scientific workers.

The work done on hydrogenation at Greenwich, though it has not yet developed to anything of industrial importance bringing a direct return to the nation, is of outstanding value both as serving to introduce the high-pressure technique into its laboratories and as securing that independent and continued study of hydrogenation which is so desirable.

The experiments recorded in the Fuel Research Board Technical Paper No. 42 referred to above are now largely of academic interest, but they serve to show that catalytic hydrogenation under pressure is widely applicable to British coals. An earlier Technical Paper (No. 29) deals with observations on the conversion of a non-coking into a coking coal when heated with hydrogen under pressure.

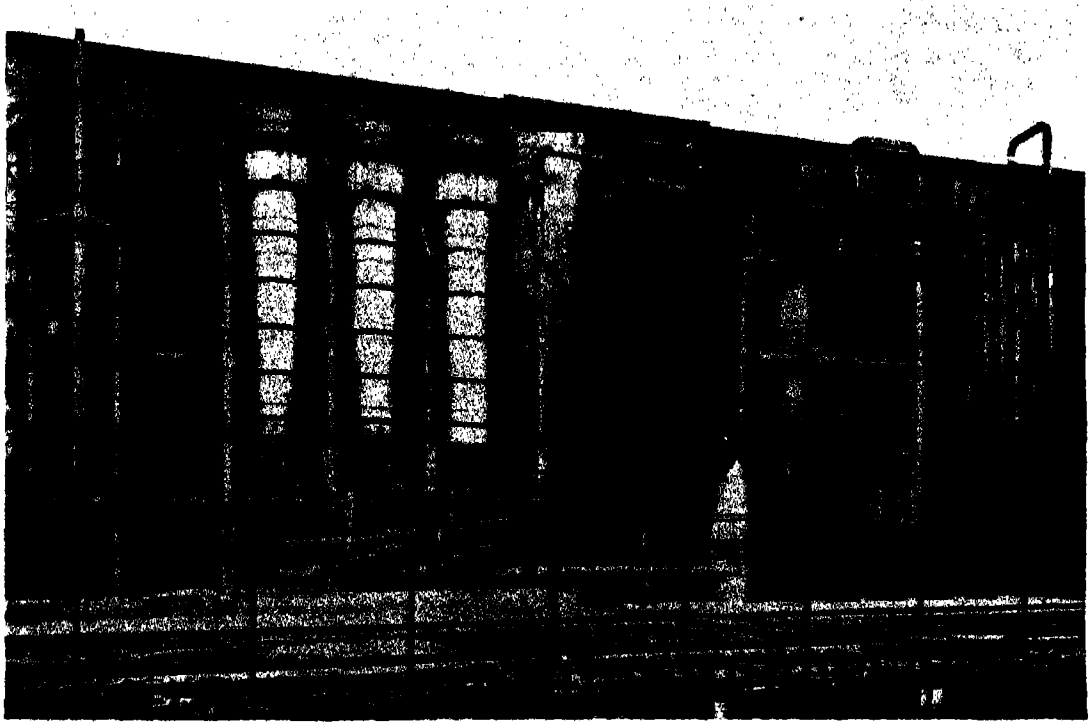

FIG. 2. General arrangement of a hydrogenation stall at Billingham. By courtesy of Imperial Chemical Industries, Ltd.

Such work is preliminary to the day when it will be realised that coal is in fact a chemical raw material and that there are many different kinds of it. Each will have to be treated in the most appropriate manner to give gaseous, liquid and solid products. The burning of raw coal will be regarded as waste, and coke of excellent quality will be available for metallurgical and domestic purposes according to its nature. The total value of these products should be far in excess of the mining cost of the coal plus the factory costs of

its subsequent elaboration, and allow of satisfactory employment to miner and factory worker and profit to mine-owner and chemical factory.

The coal question includes many pressing problems, as has been indicated. With defence in mind, the importance of home-produced oil seems paramount, and the Fuel Research Board should be urged to encourage the active study of other methods of making this, for example, from coke via water gas. Unless and until oil can be found deep down in our strata, we must depend on its production from coal and be satisfied that the amount so obtained bears a far larger proportion of the whole quantity used than is at present a fact.

# Obituary

## Prof. P. F. Kendall, F.R.S.

THE death took place at Frinton-on-Sea, Essex, on Thursday, March 19, of Prof. Percy Fry Kendall, formerly professor of geology in the University of Leeds. He was born at Clerkenwell in 1856. Like many others whose names are famous in the annals of geological science, Kendall was a product of the old Science and Art Department at South Kensington, and in the year 1874 he was awarded the Silver Medal of the Department, this being, the writer believes, the only occasion when such a distinction was gained by a student in geology.

Kendall entered the Science School, South Kensington in 1883 and here he came under the influence of those two great teachers, Judd in geology and Huxley in biology, with the result that he was most attracted to the biological aspects of geology, and his earliest work was upon the fossil fauna of the Pliocene deposits of East Anglia. It is interesting to record that he again took up research on these same deposits in his last years when resident at Frinton, and published a further contribution on the same subject. After leaving South Kensington he was elected Berkeley fellow of Owens College, Manchester, and was later appointed assistant lecturer in geology with Prof. (later Sir) W. Boyd Dawkins, who then occupied the chair of geology at Owens College.

Kendall had become interested in glacial geology by this time, and at the British Association meeting at Manchester in 1887, he had the good fortune to meet the brilliant American glacialist, Prof. Carvill Lewis, and encouraged by him, Kendall from that time devoted himself wholeheartedly to glacial studies. In the 'eighties, the problems connected with the Great Ice Age were receiving much attention, and he ranged himself with those few British geologists who argued that these islands had been covered by land ice, as Greenland is to-day, as opposed to those in the majority, who invoked submergence in an arctic sea with abundance of icebergs as being the best explanation of the deposits of that period. Many a pitched battle was fought upon this question in Section C of the British Association, the honours eventually all resting with the adherents of the land ice theory, of whom Kendall was one of the very foremost. His ready wit and command of language rendered him a doughty champion of any cause he espoused. He was spoken of by one veteran Scottish geologist as a "bonnie fechter".

In 1891, Kendall was appointed part-time lecturer in geology at the Yorkshire College (now University of Leeds) and he at once commenced the investigation of the glaciation of the Cleveland Hills in north-east Yorkshire. To enable him to do this the more successfully, he visited Norway to study the effects of modern glaciers and also to examine *in situ* those rocks which he was finding as pebbles in the drift of the Yorkshire coast. Switzerland also gave him many ideas, especially with regard to ice-dammed lakes such as the Marjelen See. The results of these researches were presented to the London Geological Society in a paper entitled "Glacier Lakes in the Cleveland Hills". This was published in 1902 and was an inspiration to many workers, who applied similar methods of investigation to other districts in the British Isles.

While prosecuting his glacial researches Kendall had also paid much attention to the solid geology of Yorkshire. It was part of his duties at Leeds to lecture to students of coal mining, and in order to equip himself more thoroughly for this work he took up the study of the Coal Measures, and in this branch of geology he proved himself as original an investigator as he had already done in glacial geology. For the Royal Commission on Coal Supplies in 1901–5 under the chairmanship of Lord Allerton, Prof. Kendall was asked to report upon the Yorkshire, Nottinghamshire and Derbyshire Coalfield, and in the attempt to determine the boundaries of the concealed coalfield on the north-east and south, where the Coal Measures are overlain uncomformably by newer rocks, he applied the principle of 'posthumous folding', the argument being that the foldings traceable in the newer covering rocks represent renewed activity along lines of folding already established in the older rocks below before the newer rocks had been laid down. The total area of the unproved coalfield was by this means estimated by Prof. Kendall to be 3,885 square miles, and whether or not this be established by future exploration, it is still true to say that the report forms a most stimulating and illuminating contribution to the tectonics of this great coalfield.

Another phase of Coal Measure geology engaged Kendall's attention for some years, namely, the abnormalities of coal seams and the adjacent beds

of sandstone and shale. The similarity of the phenomena presented in the strata of the Coal Measures with those recorded where alluvial beds had been traversed by recent earthquakes as in India and America led Kendall to see in the disturbances in the Coal Measures a number of 'fossil earthquakes', an idea which is engaging the attention of investigators in many other sedimentary deposits.

Prof. Kendall became a fellow of the Geological Society of London in 1889. The Society awarded him the Lyell Fund in 1895, and in 1909 further recognised his distinguished contributions to geological science by awarding him the Lyell Medal. He also served on the Council of that Society for some years. In 1922 he retired from the chair of geology at the University of Leeds, and two years later was elected a fellow of the Royal Society. The University of Leeds in 1926 conferred upon him the degree of doctor of science, *honoris causa*. In collaboration with Mr. H. E. Wroot he wrote the "Geology of Yorkshire", which was published in 1924 and is generally admitted to be one of the most 'readable' books on geology extant. A. G.

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WE regret to announce the following deaths:

Lord Invernairn, who as Sir William Beardmore was president in 1917 of the Iron and Steel Institute, on April 10, aged seventy-nine years.

Prof. J. P. Khomenko, an authority on the Cenozoic palæontology and stratigraphy of the U.S.S.R., on August 7.

Prof. J. M. Page, formerly professor of mathematics, and dean of the University of Virginia, an authority on the calculus, on March 12, aged seventy-two years.

Prof. James Rice, associate professor of physics in the University of Liverpool and author of noteworthy books on the theory of relativity, on April 17, aged sixty-two years.

# News and Views

### Experiments on Mammalian Embryos

THE technical difficulties of experiments on embryos removed from the uterus are only very slowly being overcome. Nearly a quarter of a century ago, Brachet showed that the rabbit egg could be kept alive and developing for a short time in tissue culture, and slightly, but only slightly, better results have been obtained by later workers. Another method is to transplant the egg obtained from one animal into a new mother. The experiment was first successfully performed by Heape in 1890; he transferred the segmenting eggs of an Angora rabbit into the uterus of a Belgian hare, and got a normal development of Angora young. The transplantations can only be carried out with very young eggs, but there are many problems relating to the early stages of development which might be investigated in this way, and in recent years the method has been taken up again and several interesting results have been obtained. Thus Nicholas and Hall have been able to follow the development of isolated rat blastomeres into complete embryos, although they could not maintain the development for the full period of pregnancy.

PINCUS has combined the experiments of tissue culture and transplantation, and has recently, as reported in *The Times* of March 30, been able to verify the occurrence of parthenogenesis in the rabbit. His first experiments on the tissue culture of the rabbit egg, made at the Strangeways Research Laboratory some six years ago, showed that the unfertilised egg is very sensitive to external conditions, and may start to cleave under the influence of slight changes of temperature or the osmotic pressure of the medium. The attempts which were then made to transplant the parthenogenised eggs to other mothers were unsuccessful; but in his recent work the transplanted eggs have undergone normal development and eventual birth. Transplantations of older embryos into the uterus are not successful, and attempts have been made to find other transplantation sites (kidney, mammary gland, omentum, chamber of the eyeball, chick chorio-allantois), but the results have not been very encouraging. The tissue culture method, imperfect as it is, is still the only one which has made possible experiments on the crucial period of gastrulation, when, by analogy with other vertebrates, one may expect the major processes of determination to occur.

### Sir George Grierson and Indian Linguistics

THE commemorative volume "Indian and Iranian Studies" presented to Sir George A. Grierson by friends and admirers on the occasion of his eighty-fifth birthday on January 7, and published as a special issue by the School of Oriental Studies of the University of London (*Bull.*, 8, 2–3, 504. 25*s*.), is a remarkable tribute to even so great a scholar. This will be most readily appreciated in the extent to which it shows how those who have here united to do him honour—fifty-three scholars drawn from thirteen different countries, including India and the United States—have been indebted to him in outlook or method or as a contributory source of their material. In this volume of "Studies" not unnaturally, and as is usual in collections of its class, a considerable proportion is of highly specialised interest, though even here certain of them as, for example, the communications dealing with the Karosthi material retrieved from the Central Asiatic Desert by Sir Aurel Stein or Colonel D. L. R. Lorimer's "Nugae

Burushaskicae", glance at broader issues. Others, however, such as the contributions by Dr. T. Grahame Bailey or Prof. A. Barannikov, to name two only, which deal with the relation of the Sanskritic to other elements in the vernaculars, or Dr. F. Otto Shrader on the Uralian element in the Drâvidâ and the Munda tongues, have a direct interest for those who are dealing with current problems in Indian ethnology; while the value of linguistic studies in cultural investigation is shown by such inquiries as those of Prof. J. Block on the character of the Vedic plough and the late Dr. J. Charpentier on the meaning of 'Śakudhūma' and the suggestion arising therefrom as to ritual recognition of the Pleiades in Vedic times. It is remarkable, however, how on every side there is evidence that in these investigations the work of Sir George Grierson and his linguistic survey of India have been fundamental.

### Chemical Society: Annual General Meeting

THE ninety-fifth annual general meeting of the Chemical Society was held under the presidency of Prof. N. V. Sidgwick in the University of Bristol on Thursday, April 16. Fellows and their guests were received by Dr. Stanley H. Badock, treasurer and pro-chancellor of the University. At the annual general meeting, it was reported that the following had been elected on the Council: As vice-presidents who have filled the office of president: Prof. H. E. Armstrong and Sir William Pope. As vice-presidents who have not filled the office of president: Mr. J. Davidson Pratt, Sir Robert Robertson and Prof. R. Robinson. As honorary secretary: Prof. J. W. Cook. As ordinary members of council: Town Members: Prof. C. K. Ingold, Dr. R. P. Linstead and Dr. R. E. Slade. Country Members: Prof. G. R. Clemo, Mr. T. W. J. Taylor and Prof. R. V. Wheeler. The presidential address delivered by Prof. Sidgwick was on "Structural Chemistry: Old and New".

THE Longstaff Medal for 1936 of the Chemical Society was presented to Prof. George Barger, and in making the presentation the president stated that it was the highest distinction which the Society could bestow on one of its fellows. He referred to the importance of Prof. Barger's researches on natural products of physiological interest, mentioning his researches on ergot and its constituents, and to Prof. Barger's work in increasing our knowledge of a large number of alkaloids, many of which he had synthesised. In presenting the Harrison Memorial Prize for 1935 to Dr. Leslie E. Sutton, the president remarked that the prize, which was founded in memory of an eminent fellow of the Society who gave his life to the service of his country in the Great War, is awarded every three years to the chemist less than thirty years of age who has made the most meritorious original contributions to chemical science. The president referred to Dr. Sutton's work in increasing our knowledge of molecular structure, which has helped to elucidate the formulæ of divalent carbon compounds, the oximes and the azides; he also referred to his work on the relation between dipole moment and substitution in benzene derivatives, and on electron diffraction. The anniversary dinner of the Society was held in the Great Hall of the University of Bristol on the evening of April 16. Prof. N. V. Sidgwick presided; and the number present was 158. The Hantzsch Memorial Lecture was delivered by Prof. T. S. Moore in the H. H. Wills Physics Lecture Theatre of the University of Bristol on Friday, April 17.

### British Society for International Bibliography

THE eighth ordinary meeting of the British Society for International Bibliography was held in the Science Museum, South Kensington, on March 25. After the president, Prof. A. F. C. Pollard, had opened the meeting, Dr. Van Heurn, director of the Intelligence Bureau of the Amsterdam Laboratories of the Royal Dutch Petroleum Co., gave a description of the work and organisation of this Bureau. The secretary of the Society, Mr. E. Lancaster-Jones, followed with an account of the progress of the English edition of the Universal Decimal Classification. He reported that the first fascicule of the work is now available, while the second will be ready very shortly. Messrs. Simpkin Marshall, Ltd., are the British agents. The main item on the agenda—a discussion on the preparation of indexes to periodical bibliographies and allied publications—then followed. This was opened by Dr. P. S. Hudson, deputy director of the Imperial Bureau of Plant Genetics at Cambridge, who described the preparation of the yearly cumulative indexes to *Plant Breeding Abstracts*, the quarterly publication of his Bureau. The abstracts are classified by the Universal Decimal Classification; hence the preparation of the index, in which the entries are arranged in numerical order of their classification numbers, is extremely simple.

DR. A. S. NEAVE, assistant director of the Imperial Institute of Entomology, then spoke on the alphabetical index to the *Review of Applied Entomology*, pointing out the advantages of this type of index over a numerical one, in the particular case of this subject, with its extremely detailed nomenclature and its somewhat volatile systematisation. The discussion following centred around the relative advantages of a classification as the basis of an index. Dr. S. C. Bradford contended that most alphabetical indexes are based on concealed classifications. Mr. W. T. Astbury instanced the difficulty of obtaining uniformity in alphabetical indexing among a number of contributors. It was pointed out that a classified index in no wise precludes the employment of explanatory terms, or standard nomenclature. The classification itself possesses an alphabetical index, which serves automatically to correlate all synonyms to a unique class symbol, and thereby saves unnecessary repetition.

### The Reclamation of the Zuider Zee

THE epoch-making enterprise on which the Dutch nation embarked in 1920, and which is ultimately destined to add to the Netherlands more than half a

million acres, or about 7 per cent of the former area of the country, is now about to be advanced a further stage towards completion. It is announced from The Hague that a sum of two million florins (about £154,000) has just been voted in the national budget for continuing the work of reclaiming the Zuider Zee, and it is likely that additional grants will follow shortly. The scheme was described in detail in an article which appeared in the issue of NATURE of September 21, 1929 (p. 446), at which date the first section, the North-west Polder of 50,000 acres, was at the point of complete enclosure. This polder was pumped clear of water in the following year, and it has since been brought into cultivation with satisfactory results. It is now intended to proceed with the reclamation of the second section, the North-east Polder, containing 117,000 acres. The cost is estimated at about £9,600,000 and the work will take about five years, providing work for about 5,500 men. Another ten years will be required to bring the salt-saturated soil into a completely effective state of productivity. The outer dyke, or embankment, enclosing the polder, starts from Lemmer in Friesland and follows a widely sweeping curve, first westerly, then southerly and finally easterly to a point on the coast-line north of Kampen. It will be 35 miles long, and for a great part of that distance will run parallel to a new canal. The reclaimed area will lie at two different levels, one about 13 feet and the other about 18 feet below water-level at Amsterdam, and three large pumping stations are to be provided to deal with the fresh-water drainage after completion.

### Oldbury Hill, Ightham

AN attempt to save Oldbury Hill, Ightham, from development for building purposes, is one which has a strong claim on the practical support of all archæologists. This Kentish woodland plateau, lying between Sevenoaks and Ightham, is for British archæology historic ground. At its summit is a prehistoric fortress, which is dated at about 200 B.C.; but its chief interest lies in its evidence of prehistoric man of a far earlier period. It is a part of the country over which Benjamin Harrison of Ightham, the apostle of the eolith, had his hunting ground; and through him it is linked with the great names in the study of British archæology—Sir Joseph Prestwich, Sir John Evans, Lord Avebury, and many others. The fortress itself is scheduled for protection under the Office of Works, and in the event of building development, provision for access will have to be made in the inevitable encroachment; but the character of the site with its associations and its wide views over pastoral lands, which preserve the meaning and purpose of its fortification, will be irretrievably lost. The extent of the estate now offered for sale is about 157 acres, and the owner, who is not in a position to present the site to the public, has fixed at the lowest possible figure the price at which he would be prepared to effect a transfer to the National Trust. This body, however, has no funds with which to purchase; but an effort is being made, up to the present with indifferent success, to organise a local fund. The importance to science of the high terrace gravels in which the evidence has been found for what is claimed to be the earliest traces of man's handiwork is obvious; the fact that that evidence has not been accepted universally makes it all the more important that such a site as Oldbury Hill should be preserved for the inspection and investigation of later generations.

### History of the English Parliament

IT is announced that H.M. Stationery Office will publish at an early date a volume, the first to be issued, of the "History of Parliament", which has been in course of preparation for some time under the supervision of a committee presided over by the Marquess of Salisbury. This undertaking, which will cover the whole period of parliamentary government from its inception in 1264 up to 1918, is an outcome of the report of a committee which was appointed in 1929 with Colonel J. Wedgwood as its chairman, to examine the material available for a record of the personnel and politics of the members of the House of Commons. A joint meeting of both Houses decided that the scope of the work should be extended so as to make it as complete a record as possible of "the people in Parliament—their ideas, standing, and politics—and to trace the gradual growth of Parliamentary representation and government". The work will fall into seventeen or eighteen periods, the material for each being grouped into two or three volumes. This material will comprise biographies of members of the Commons, complete lists of the members of both Houses with identifications, a preface to each Parliament with a commentary on its composition and the work done, and conclusions, appendixes, documents, etc. It is expected that the "History" will consist of some forty volumes, and that it will be completed in about thirty years; but as the price—possibly not more than £2 2*s.* per volume—will cover cost of printing and publication only, the rate of production will depend upon the funds available for the collection and preparation of the material. For the first volume to be issued, covering the period 1439–1509, Colonel Wedgwood, it is understood, has been largely responsible. Subscribers to the whole work will be charged three-quarters of the published price, a first payment of £10 being required with the undertaking to subscribe, against which the cost will be charged as each volume is issued.

### Higher Paraffins as Liquid Fuel

HIGHER paraffins such as butane are easily liquefied at air temperature, and give a concentrated and easily vaporised liquid fuel—the most concentrated fuel commercially available having a heating value of 21,000 B.T.U. per lb. In several countries this product has been recovered from natural sources or oil refineries, and distributed in cylinders. In the United States this 'bottled gas' has become extensively used in rural areas, and the development of coal hydrogenation in England has led to its being marketed now under the name of 'Calorgas'.

H. Pickering recently described its properties before the Institute of Fuel, and there is little doubt that the gas, which is practically free from sulphur, will find many applications where a public gas supply is not available. The scope will be more limited under British conditions owing to the wide dispersion of gas mains and the low price of public supplies per therm. On the figures given, the price of the unit of heat in Calorgas is 29*d*. per therm. In the compressed gas trade, the cost of cylinders and distribution usually form the main item, and so it seems that the use of 'bottled gas' will depend on the extent to which those charges can be lowered by developing the market.

### Electrical Measurements in the Eighteenth Century

IN the *Annals of Science*, 1, No. 1, January 1936, Mr. W. Cameron Walker, of Minchenden School, London, gives an interesting historical account of the detection and estimation of electric charges in the eighteenth century. Perhaps in no other branch of science could he have found a better illustration that progress in science is conditioned by the invention and improvement of instruments. Up to the time of Volta, Bennet's familiar gold leaf electroscope was the most sensitive detector of electricity. Its invention marks the end of a period of evolution beginning with the time when the experimenter obtained electrical charges by simply rubbing pieces of amber, glass or sulphur on his coat. Boyle and Newton had in turn extended the observations of Gilbert concerning the attractive powers of electrified bodies, while von Guericke came very near to anticipating Du Fay in the recognition of two opposite states of electricity. But to Hauksbee, with whom the story of the eighteenth century begins, belongs the credit of the first systematic investigation of 'electric effluvia'. He was surprised to notice that threads enclosed in an 'uncharged' globe of glass were immediately affected by the approach of a rubbed rod of sealing wax. But he makes no reference to the repulsion of the threads. For this new step we have to wait until twenty years later. In 1767, when describing a Leyden jar, Priestley writes that what electricians chiefly want to know is 'how high a phial is charged'. Methods of measuring this were soon described by Lane and Henly. Then we come to the wonderfully accurate experiments of Cavendish and the evolution of the condensing electrometer by Volta—the most skilful worker in this field. We think Mr. Walker has done well to direct attention to the valuable work done by eighteenth century electricians.

### Preservation of Cornish Engines

IT is with pleasure we learn that the Cornish Engines Preservation Committee has been successful in acquiring the early winding engine at Levant Mine in Cornwall, and in leasing for a small acknowledgment rent the engine house. Levant and the adjoining Botallack mine were famous for their richness in copper and tin, and for their deep workings, which extended far out under the Atlantic Ocean. The engine at Levant was designed by Francis Michell, and was probably built at the Copperhouse Foundry, Hayle, about one hundred and ten years ago. It is of the beam type with parallel motion, and has a cylinder 24 in. in diameter with a stroke of 4 ft. The total sum raised for its preservation was £130, the greater part of which, says Mr. W. T. Hooper, the honorary secretary of the fund, came from beyond the Tamar. Donations were received from the Institutions of Civil and Mechanical Engineers and the Newcomen Society, and from individuals in India, China, Australia and America. The Committee has in view the preservation of some of the larger pumping engines, and arrangements are now being made to complete the model of the 90 in. pumping engine at East Pool Mine, which was begun by the late Mr. Oswald Swete of Truro.

### National Academy of the Lincei

AT a meeting of the National Academy of Lincei held in Rome on June 2, 1935, in the presence of H.M. the King of Italy, an account of which has just been issued by the Academy, it was announced that the new statutory regulations of the Academy, which have received the royal sanction and the approval of the head of the Government, are now being put into operation. The most notable of these regulations, because it symbolises the strict adherence of the Academy to the Fascist regime, is that the nomination of the president and vice-president (still to be announced) and of the national members is made by royal decree proposed by the Duce. The following members have been nominated under the new statutes: L. Berzolari, U. Amaldi, A. Crocco, E. Soler, A. Alessio, E. Fermi, G. Vallauri, F. Giordani, R. Fabiani, G. Quagliariello, P. Rondoni, C. Formichi, G. Bertoni, C. M. de Vecchi, L. Federzoni, G. Volpe, P. S. Leicht, A. Torre, A. Carlini, P. Carabellese, G. Della Valle, A. Solmi, S. Riccobono, S. Romano and A. de Stefani. Among the chief awards announced are the following: Prizes presented by H.M. the King: the late Prof. G. Viale, University of Genoa, for his work on physiology and pathology, and A. Maiuri, for his contributions to archæology; Cannizzaro Prize in chemistry, Prof. P. Karrer, University of Zurich, for his work in biochemistry; Santoro Prize: G. Fauser, for his scientific services to the nitrogen fixation industries. In his address to the Academy on "The Tradition of Rome in the Middle Ages", Pietro Fedele concluded by emphasising the glorious role of Fascist Rome as the true successor of the Rome of the Cæsars and of the Popes.

### The Meaning of 'Survival'

IN the fourth Frederic W. H. Myers Memorial Lecture, which was given by Mr. Whately Carington on October 30, 1935, and is now published by the Society for Psychical Research, the speaker stressed the importance of language in any serious consideration of the problem of 'personal survival' after bodily death. He pointed out that one of the great difficulties of the subject lies in the incorrect use of terms, which, although they might mean something in connexion

with matters for which they are intended, yet might be quite meaningless when applied outside their legitimate limits. Thus it is possible, and indeed probable, that many of the questions propounded might be really quite meaningless; and therefore it is unlikely that any sensible answers can be found for them. It was here that Mr. Carington urged the more extensive use of a mathematical type of language in which the symbols employed do not suggest any relationships other than those deliberately assigned to them. In conclusion, Mr. Carington briefly referred to his recent studies of trance personalities, where, through statistical methods, a clearer understanding is being achieved and light is being thrown on the problem as to how these secondary or multiple personalities differ or not from other communicating personalities, which operate through the so-called mediumistic trance.

### Air Mask to Protect Workers

AN air mask which will provide the rock driller, painter or chemical worker with fresh air and protect him from poisonous gases, smoke and dust is described in a recent report by Science Service, of Washington, D.C. The mask is literally a film or curtain of air completely covering the user's face but leaving the eyes, nose and mouth free. When it is intended for use as the conventional gas mask, the new mask is a shield similar to an eye shade and worn on the forehead. The visor of the shield contains an air chamber, provided with numerous outwardly slanting openings at its lower edge. When air under pressure is forced into the chamber, streams of air issue outwardly and downwards from the openings, and form a transparent air screen or curtain completely covering the face but at some distance from it. With this air film for protection, the user could pass through dust, smoke, gas or paint fumes without any of them coming in contact with his face. The inventor also claims that there would be no trouble in breathing, the air curtain furnishing a continual supply of fresh air.

### The *New Guinea Agricultural Gazette*

THE editors of the *New Guinea Agricultural Gazette* are to be congratulated on the first number (1, No. 1, October 1935. Pp. 50. Rabaul: Department of Agriculture) containing articles on the cultivation or marketing of five crops of economic importance to New Guinea, besides others on entomology and meteorology. The appearance of the journal is another indication of the indispensability of at least a little science to every planter or agriculturist. Many of the most isolated countries in the world now issue semi-scientific agricultural periodicals which, since they can scarcely be financially profitable, must be produced in response to a demand for knowledge. The *Agricultural Gazette* shows that the New Guinea planters and Agricultural Department are fully alive to the fact that science is as necessary to the prosperity of a small colony as of a highly developed country.

### Fruit Tree Pests

THE classification of insects by the damage they cause is not, perhaps, scientific, but is of great practical use to the gardener. Mr. G. Fox Wilson outlines such a classification of fruit tree pests (*J. Roy. Hort. Soc.*, December 1935). Feeding habits of different types of fruit tree pests are discussed, and the structure of the mouth parts is considered in relation to their effects on the plant. The work of Nierenstein on gall formation is passed under review, and the effects of 'honeydew' are discussed. Very little new knowledge is contained in the paper; its main value lies in the convenience of its outlook from a horticultural point of view.

### News Value of Science

IN an address to the Georgia Press Institute and the Henry W. Grady School of Journalism, University of Georgia, on February 19, Mr. Watson Davis, director of Science Service, discussing the news value of science, suggested that though we have largely left the stage in which the man of science was regarded as a mysterious being or magician, possessed of powers for good or ill, and regarded him as a person who could provide us with many of the wonders of our daily life, we have yet to reach the stage in which science is regarded as a guide for personal conduct and political affairs. That will come as fast as education in the scientific habit of thinking, particularly through the Press, allows it to come. Great improvements have been witnessed in the fifteen years since Science Service was first formed for the reporting and interpretation of science, and the cooperation established in this way between journalists and men of science in the United States has already had very valuable results. Science is receiving much more serious attention from the daily Press, and already a number of science editors are on the staffs of American newspapers. The combination of journalistic ability and scientific attainment which is essential in a good interpreter is, however, not easy to find, and Mr. Davis also emphasised the danger which the very popularisation of science may offer to the maintenance of scientific standards. Inaccuracy must not be the price of more effective distribution of scientific knowledge to the public.

### Freezing of Niagara Falls

FROM the office of the High Commissioner for Canada a special bulletin has been received dealing with the freezing of Niagara Falls. This was prepared by Mr. G. H. Wood, assistant engineer, Dominion Water Power and Hydrometric Bureau, Department of the Interior, Ottawa, and states that the American falls became completely frozen over on January 25 this year and remained so at least up to the date of the bulletin (February 20), a length of time never previously recorded. Freezing was rare in the early days before the diversion of much of the water for power purposes and the present low cycle of discharge from Lake Erie, and did not occur once between the earliest recorded occasion in 1848 and the next occasion on February 14, 1909. It appears that there

is no record of the Canadian falls (Horseshoe falls) having ever been frozen over; but the channel leading to the American falls is shallow and carries only five per cent of the flow over the cascades, and, becoming obstructed by ice at times, may then be frozen over. Such an event is always due to ice jams at the head of Goat Island, which occur when thick ice on Lake Erie is broken up by strong south-westerly gales, and large quantities of floe ice are driven into the Niagara River and carried down-stream. The level of Lake Erie is stated to be close to its minimum recorded level, and the discharge of the river very low in consequence. The comparative frequency with which the falls have been frozen over (for a short time) since 1922 is clearly, therefore, no evidence for an increase in the average severity of American winters; in fact, temperature records show just the reverse in spite of the occurrence of a few isolated spells of unusual cold within the last few years.

### Determination of Hydrogen Ion Concentration of Soils

THE British Drug Houses have recently brought out a new type of soil-testing outfit for determination of *p*H values, in which barium sulphate is used as a clarifying agent. This enables the determination to be made with a greater degree of precision than has hitherto been possible, particularly in the case of clay soils. The outfit has been designed in response to a persistent demand for means of estimating *p*H values conveniently and accurately in the field, and is fitted up in a compact oak cabinet of readily portable form. The cost of the complete outfit is £1 1*s*., and prices are also quoted in the descriptive pamphlet (issued by British Drug Houses) for the individual items, should need arise for their replacement.

### Directory and Buyers' Guide, 1936-37

THE *Engineer* is the oldest and one of the most influential journals in Great Britain dealing with the progress of engineering. In the interests of the firms advertising in the paper, the proprietors publish every two years a useful directory of about 250 pages. The first 38 pages give an index and vocabulary in French, German, Italian and Spanish of the technical words used in the book. The next 156 pages give an alphabetical list of the manufacturers together with their telephone numbers and telegraphic addresses. The next section gives their telegraphic addresses and the codes they use. Finally a carefully selected list is given of the numbers and titles of British Standard Specifications. The guide has been carefully prepared, and should prove useful to consulting engineers and contractors. It is issued free of charge by the proprietors of the *Engineer*. To qualify for inclusion under appropriate headings, it is necessary to advertise in the columns of the *Engineer* to the extent of £25 a year.

### The Original Use of the Word "Solute"

DR. P. LECOMTE DU NOÜY, writing from the Institut Pasteur, Paris, asks if it is known who is responsible for the coining of the useful word 'solute'. The word is not to be found in old text-books, but the "Oxford English Dictionary" gives a quotation from Sir William Dampier's "Recent Developments of Physical Science" in which the word is used in its present sense. Upon referring the point to Sir William, however, he informs us that the Dictionary is wrong in implying that the first use of the word is in that volume, which was first published in 1904. In his "Theory of Solution", published two years earlier, he says (p. 49), "It is customary to distinguish between the medium or *solvent* and the dissolved substance or *solute*". On the other hand, in his "Solution and Electrolysis", published in 1895, Sir William uses the word 'solvend' instead of 'solute'. Apparently, therefore, the word 'solute' was introduced between 1895 and 1902, but who was responsible for the coining of it remains undecided. Perhaps some of our readers can throw light upon the question.

### Heavy Water and the Colour of Hydrated Salts

IN connexion with his communication on the influence of heavy water on the colour of hydrated salts (NATURE, March 28, p. 534), Dr. James Bell writes that it appears that the observation that copper sulphate pentadeuterate solutions and crystals are more green in tint than those of the pentahydrate had already been made. H. Perpérot and F. Schacherl, in an account of an investigation of the vapour tensions of the different deuterates of copper sulphate (*J. de Physique et le Radium*, vii, 6, 439; Oct. 1935), mention this difference in colour, and state that they have undertaken an examination of the absorption spectra of the solutions. As it is unusual for work on this field to be published in that journal, and an abstract has not yet been available, this paper was inadvertently overlooked.

### Award of Goethe Medal

IT is announced that Herr Hitler has conferred the Goethe Medal on Dr. Max Uhle, of Berlin. Dr. Uhle, who is an honorary fellow of the Royal Anthropological Institute, has a world-wide reputation as one of the foremost authorities on South American archæology. During a residence there of many years he explored a large number of prehistoric sites in Peru, some of his work in the field being supported by grants from the Phœbe B. Hearst benefaction of the University of California. His studies, more particularly of the pottery, are the basis of generally accepted views on the character and chronology of Pre-Inca civilisation.

### International Association on Quaternary Research

THE third International Conference of the International Association on Quaternary Research will be held in Vienna, on September 1–7. After the conference, excursions will be made to the East Austrian Alps and their forelands. These excursions will start on September 9 and continue until September 25. Those who propose to attend the conference and excursions should write at once for further details and approximate cost to the president, Prof. Dr. Albrecht Penck, c/o Inqua, Rasumofskygasse 23, Vienna III, Austria.

**Announcements**

THE Council of the Linnean Society has awarded the Linnean Gold Medal for 1936, the highest award in the gift of the Society, to Prof. J. Stanley Gardiner, professor of zoology and comparative anatomy in the University of Cambridge.

THE Lord President of the Council has decided that, pending the appointment of a successor to the late Sir Joseph Petavel, the office of director of the National Physical Laboratory shall be held by Sir Frank Smith, the secretary of the Department of Scientific and Industrial Research. Correspondence should be addressed as hitherto to the Director, National Physical Laboratory, Teddington, Middlesex.

THE following appointments have recently been made by the Secretary of State for the Colonies: H. E. Harbour, to be veterinary officer, Tanganyika Territory; C. L. Smith, to be chemical assistant, Sponge Fishery Investigations, Bahamas; J. R. P. Soper (agricultural officer, Zanzibar), to be agricultural officer, Straits Settlements and Federated Malay States; A. Foggie (assistant conservator of forests, Cyprus), to be assistant conservator of forests, Gold Coast.

THE University of Jena will celebrate the seventh centenary of its foundation on May 20–24.

THE eighth International Congress of Theoretical and Applied Limnology, which was to have been held in Paris this year, has been postponed until 1937, when the world exhibition will take place.

THE First National Prize for Science, which is the highest distinction conferred by the Argentine Republic, has been awarded to Dr. Julio Diez for his work on the surgery of the lumbar sympathetic.

THE fifth International Congress against Rheumatism will be held at Lund on September 3–8, under the presidency of Prof. Sven Ingvar. Further information can be obtained from the secretary, Prof. G. Kahlmeter, Birgerjarisgatan 36, Stockholm.

THE third International Conference on Social Work will be held at Bedford College, London, on July 12–18, when the subject for discussion will be social work and the community. Further information can be obtained from the general secretary, Mr. Alexander Farquharson, Le Play House, 35 Gordon Square, W.C.1.

THE eleventh International Congress of Psychology will be held in Madrid on September 6–12, under the presidency of Prof. E. Mira. Further information can be obtained from the Bureau of the Congress at the Instituto Nacional de Psicotecnia, Alberto Aguilera 25, Madrid.

THE British Health Resorts Association has recently issued the 1936 edition of its official handbook, edited as previously by Dr. R. Fortescue Fox, and with a foreword by Sir Kingsley Wood, Minister of Health ("British Health Resorts Spa, Seaside, Inland. Including those of Australia, Canada, New Zealand, South Africa and the British West Indies". London: J. and A. Churchill. 1*s*. net). Year by year the details included become amplified, and we now have a very full and complete guide to all the spas and health resorts in the British Isles, together with those of the overseas Dominions. Medical indications of the spas and the 'qualities' of the sea-coast health resorts are summarised. This, together with a guide to hotels and accommodation for visitors, complete a useful and inexpensive handbook.

WE are asked by Messrs. H. K. Lewis and Co., Ltd., to state that they are the London agents for the *Proceedings of the Prehistoric Society*, referred to in NATURE of April 11, p. 629.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, 10 Whitehall Place, London, S.W.1 (April 27).

An assistant (Grade III) in the Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7—The Director (April 30).

A civilian technical officer (engineering or physics) in an Admiralty establishment in Scotland—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 1).

A mechanical draughtsman (temporary) at the War Office in connexion with research work in air survey—Under-Secretary of State (C.5), War Office, London, S.W.1 (May 4).

A junior scientific officer (physicist) at the Fuel Research Station, Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 8).

A chemist for the Admiralty Chemical Pool—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 8).

Assistants (Grades II and III) for the Admiralty Scientific and Technical Pools—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 8) (quote C.E. 2329/36).

An assistant in cereal breeding at the Scottish Plant Breeding Station, Edinburgh—Mr. John Stirton, 8 Eglinton Crescent, Edinburgh (May 9).

An assistant superintendent of the Archæological Survey of India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 15).

An assistant engineer for the Posts and Telegraphs Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/3967).

Executive engineers (Grade IV) for Public Works Department, Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4228).

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 708.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Value of Carbon Dioxide in Counteracting Oxygen Lack

THE recent paper by Childs, Hamlin and Henderson[1] has again centred attention upon the old observations of Mosso[2], who showed that in low-pressure chamber experiments the presence of small concentrations of carbon dioxide (2–5 per cent) increased the resistance of his experimental subjects to lowering of the barometric pressure. Similar observations were reported by Margaria[3], and Talenti[4], who found that the resistance against the lowering of the barometric pressure was increased in the presence of carbon dioxide, provided that the gas mixture in the chamber was pure oxygen. The attempts, however, to prove that carbon dioxide had a similar beneficial effect on oxygen lack when air was diluted by nitrogen gave paradoxically negative results (Margaria[5]). In view of the contradictory character of these earlier studies, and since it has been shown that oxygen lack produces quantitatively measurable effects on the human central nervous system (Gellhorn and Spiesman[6], and Gellhorn and Kraines[7]), it seemed to be of considerable interest to investigate whether the effects of oxygen lack on the human central nervous system could be alleviated or altered by the presence of carbon dioxide and, furthermore, to ascertain what the mechanism of this reaction might be.

In the first series of experiments, the distinction threshold of the human eye for differences in brightness was investigated by means of Masson disks. It was invariably found that oxygen want, produced by breathing concentrations of 8–9 per cent oxygen in nitrogen, decreased the sensitivity to brightness considerably. On repetition of the same experiment carried out in the presence of 3 per cent carbon dioxide there was either no change in the threshold for brightness distinction or a small reduction, which frequently disappeared even while the subject continued to breathe the same gas mixture. The experiments indicate that under the influence of carbon dioxide the effect of oxygen lack on this visual function is either completely absent, or the slight decrease in sensitivity which may occur is restored while the subject is still exposed to oxygen lack.

Experiments carried on with a brain stem reflex in the rabbit (stimulation of the vestibular apparatus with a low-voltage constant current) gave similar results. Whereas under the influence of oxygen lack the number of nystagmic movements decreases, no change may be observed in the presence of carbon dioxide. In these cases, however, a slightly higher concentration than that which has been shown to be effective in man had to be used (5–6 per cent).

Various mental functions were investigated in experiments in which the so-called number-cancellation-test, the summation of two numbers using the method of Kraepelin, and the association test devised by Kent-Rosanoff, were carried out. The time necessary to cross out a certain number in a given set of numbers, or to add two subsequent numbers, was regularly increased under oxygen lack. The association test produced, under oxygen lack, apparently senseless associations (dissociations), a stereotype character of responses to the stimulus word (perseverations) and relative increase in the number of individual responses. These changes are similar to those observed in some mental diseases. Moreover, unusual misspellings are frequent. If, however, these tests were carried out in the presence of carbon dioxide, it was found that the oxygen want had no deleterious effects upon the responses studied. Of particular interest are the effects on writing. Fig. 1

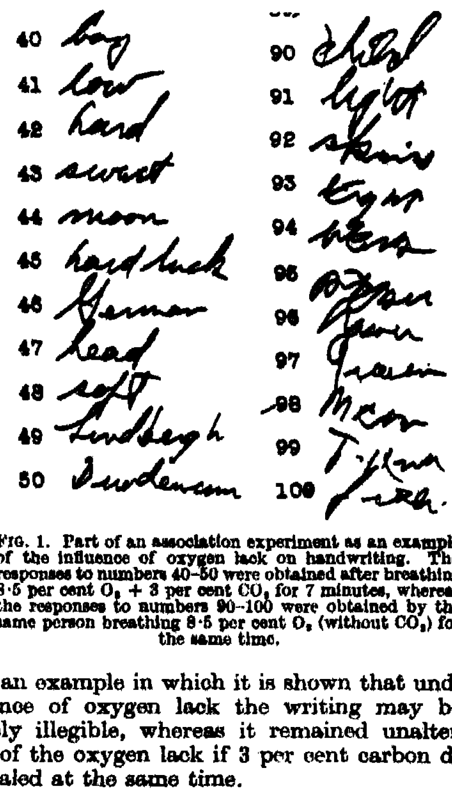


FIG. 1. Part of an association experiment as an example of the influence of oxygen lack on handwriting. The responses to numbers 40–50 were obtained after breathing 8·5 per cent $O_2$ + 3 per cent $CO_2$ for 7 minutes, whereas the responses to numbers 90–100 were obtained by the same person breathing 8·5 per cent $O_2$ (without $CO_2$) for the same time.

gives an example in which it is shown that under the influence of oxygen lack the writing may become entirely illegible, whereas it remained unaltered in spite of the oxygen lack if 3 per cent carbon dioxide is inhaled at the same time.

We believe that the mechanism by which carbon dioxide alleviates the symptoms of oxygen lack or even prevents their occurrence is based on its effect on respiration and thereby, in turn, on circulation, leading to an increase in tissue oxygen tension. The effects on circulation are particularly marked when the effect of oxygen lack with and without carbon dioxide is studied on the systolic blood pressure in the erect position in the human. Whereas 8–9 per cent oxygen lack may not cause any changes in blood pressure and only slight alteration in pulse

rate in healthy young individuals in the recumbent position, the effects are very marked in erect position, and consist, after an initial rise in systolic blood pressure, in a considerable drop which may lead to syncope. The pulse rate may show a similar change or may remain increased during the whole experiment. In the presence of carbon dioxide, however, the drop in blood pressure is prevented and may be maintained normal or may even be elevated. Obviously, carbon dioxide, by increasing respiration and by its effect on the circulation, provides a better blood supply to the brain, which is apparent in the erect position, because under these conditions the effects of oxygen lack become more severe, since a temporary cerebral anæmia frequently results from maintaining an erect position under oxygen lack.

ERNST GELLHORN.

Department of Physiology,
College of Medicine,
University of Illinois, Chicago.
Feb. 22.

[1] S. B. Childs, H. Hamlin and Y. Henderson, NATURE, 135, 457 (1935).
[2] A. Mosso, "Life of Man on the High Alps" (London, 1898).
[3] R. Margaria, *Arch. Sci. biol.*, 11, 425 (1928).
[4] C. Talenti, *Arch. Sci. biol.*, 14, 125 (1930).
[5] Margaria, *Arch. Sci. biol.*, 11, 453 (1928).
[6] E. Gellhorn and I. Spiesman, *Amer. J. Physiol.*, 112, 519, 620 and 662 (1935).
[7] E. Gellhorn and S. Kraines, *Science*, 1936, in the press.

## Plasticity of Bismuth Crystals

MUCH evidence of a conflicting nature has been advanced on the subject of the plasticity of bismuth: the following brief account of some new experiments may therefore be of interest.

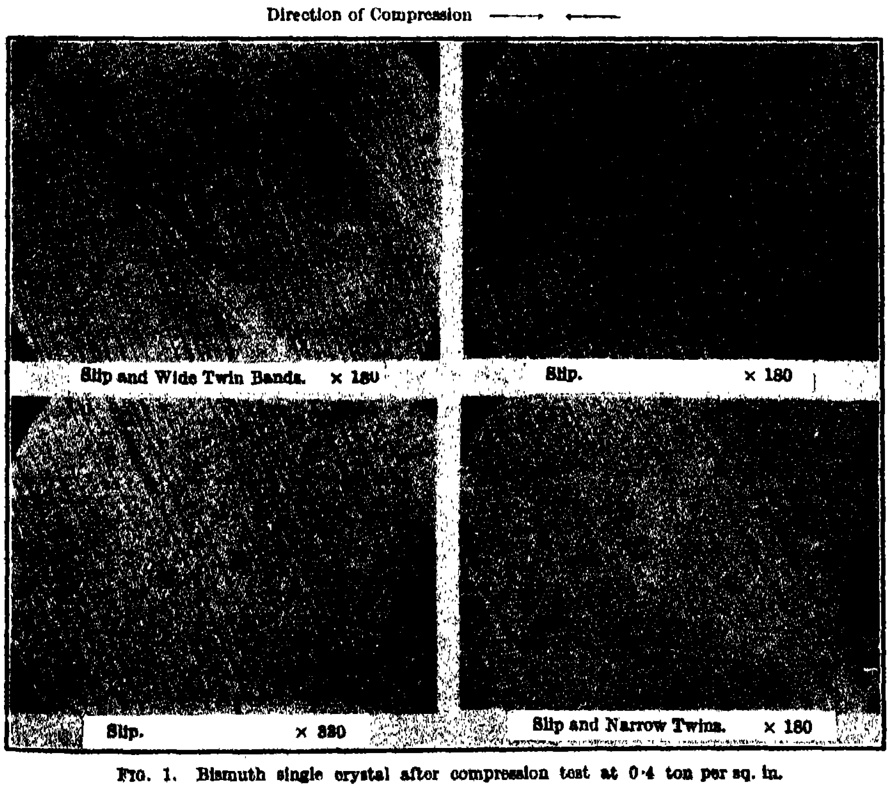


FIG. 1. Bismuth single crystal after compression test at 0·4 ton per sq. in.

In an investigation carried out at the National Physical Laboratory on the behaviour of two single crystals of bismuth when subjected to alternating torsional stresses[1], it was found that the crystals deformed entirely by twinning without any slip. The non-occurrence of slip in these tests appeared to be at variance with the conclusions drawn by other workers as to the behaviour of bismuth[2]; but it appeared possible that the difference might be due to the special nature of the applied stresses. Accordingly a third single crystal of bismuth was tested under cycles of reversed direct stresses (tension and compression). This specimen also deformed only by twinning; the final fracture was by cleavage parallel to the plane 111 (0001 in hexagonal co-ordinates), but the only visible signs of movement that could be termed slip were a few faint bands parallel to this plane (111) in the neighbourhood of the fracture. The ratio of the shear stress to the normal stress on the plane 111 of this crystal was approximately unity, so that the rule suggested by Georgieff and Schmid—that slip should occur before cleavage if this ratio is greater than 0·7—was not confirmed. Still more recently, a portion of this third crystal has been tested under static compression force applied parallel to the same axis as in the alternating direct stress tests. In this test the crystal deformed almost entirely by slip parallel to the plane 111, no regular system of twin bands being produced.

The appearance of the slip bands produced by the slip deformation is shown in the accompanying photographs (Fig. 1) It may be noted that these slip bands are not very like the bands produced by slip in aluminium, silver, iron, etc., and that in fact they appear much more like twin bands; comparison may be made with the twin bands (on the planes of the type (011)), which are also shown in the bottom right-hand photograph. Although it was not practicable in the compression test to deform the specimen sufficiently definitely to establish the shear nature of the deformation, there is very little doubt that the deformation as a whole was pure shear parallel to the plane 111. Berg[3] has suggested that the occurrence of slip in single crystals of bismuth may depend to some extent upon the applied stress conditions and upon the manner in which the single crystals are grown. The results of our tests confirm that slip may be produced in bismuth under certain types of stress system; but it appears that deformation by twinning may often occur more easily.

H. J. GOUGH.
H. L. COX.

National Physical Laboratory,
Teddington,
Middlesex.

[1] H. J. Gough and H. L. Cox, *J. Inst. Met.*, 48, No. 1 (1932).
[2] M. Georgieff and E. Schmid, *Z. Phys.*, 36, 759 (1926).
[3] W. F. Berg, NATURE, 133, 831 (1934).

## Orientation of Oxide Films on Iron

SINCE the publication of a previous note on the orientation of FeO (wüstite) films on α-iron[1], the complete series of oxide layers on iron has been studied. In the X-ray photograms of the FeO films on single crystals of iron, some reflections were identified as coming from $Fe_3O_4$, resulting from the partial decomposition of the wüstite phase. The pattern showed that this $Fe_3O_4$ was identically oriented with the FeO, with all planes of the same indices in the two cubic lattices parallel. The same orientation relationship held when an FeO film was grown by reduction on a large natural crystal of magnetite ($Fe_3O_4$).

Plots of the atom arrangement on the interfacial crystallographic planes of the Fe, FeO, and $Fe_3O_4$ lattices show that the orientation relationships described above are quite reasonable when considered on the basis of matching of atom positions. In the Fe and FeO lattices, the geometric configurations of the iron atoms on the matching cube planes are identical, and the spacings agree to within six per cent. In the matching cube planes of the FeO and $Fe_3O_4$ lattices, the configurations of the iron atoms in the two are nearly identical, and those of the oxygen atoms are exactly so, with the interatomic spacing agreeing to within about three per cent.

The orientation relationships existing in overgrowths of $Fe_3O_4$ with $Fe_2O_3$ were reported many years ago by a number of mineralogists as consisting in a parallelism of the basal hexagonal plane of the hematite and the octahedral plane of the magnetite, with the [110] direction in the match plane of magnetite normal to the [10·0] direction in that of hematite. Grüner[2] has studied this relation, and concludes that the oriented 'intergrowth' is made possible by *the sharing of one oxygen plane by both crystals*. This theory is in complete accord with the FeO–$Fe_3O_4$ orientations found in the present work. It is interesting that the oxygen atoms determine the orientation relationship in the case of $Fe_2O_3$ on $Fe_3O_4$, and iron atoms in the case of FeO on Fe, while the two possibilities would produce the same result in the intermediate case of $Fe_3O_4$ with FeO.

In 1922, Tammann[3] suggested that fixed orientation relationships between a polycrystalline metal and its adhering oxide layer would, by controlling the orientation of the oxide layer on each grain, lead to differences in the rate of oxidation from grain to grain, on the basis that diffusion through the oxide lattice is anisotropic. But though diffusion must take place by the movement of atoms from one lattice point to another and is thus anisotropic on a microscopic scale, it cannot be anisotropic on a macroscopic scale if the lattice is cubic, as demonstrated by calculations by the authors based on lattice symmetry considerations. All the existing experimental data show that diffusion in cubic metals is isotropic, as pointed out by Mehl in a recent lecture[4]. Although more or less self-evident, the calculations showed that diffusion in non-cubic lattices is not necessarily isotropic. To eliminate the effect of possible anisotropic diffusion through the thin external layer of hexagonal $Fe_2O_3$, specimens of high-purity iron were oxidised to the temper colour stage by heating in a hydrogen – water vapour atmosphere corresponding to the $Fe_3O_4$ phase field on the equilibrium diagram of Emmett and Shultz[5]; differences in rates of oxidation on different faces were again exhibited even though cubic oxide alone was formed. It is possible that the explanation of this phenomenon lies in the distortion of the oxide lattice at and close to the interface, caused by a tendency of lattices which match imperfectly mutually to adjust their lattice spacings, like that found by Finch and Quarrell[6] for zinc oxide films on zinc.

Fixed oxide – metal orientation relationships may also provide the explanation of the observed discontinuity of the rate of oxidation of iron at the $A_3$ point[7]. Since the oxide lattices themselves undergo no transformation at this temperature, the rate at which oxygen is supplied to the oxide – metal interface should not vary discontinuously with temperature. It seems reasonable to suppose that the abrupt changes in oxidation rates result from the substitution of the crystallographic mechanism of oxidation of γ-iron for that of α-iron.

R. F. MEHL.
E. L. MCCANDLESS.

Metals Research Laboratory,
Carnegie Institute of Technology,
Pittsburgh, Pennsylvania, U.S.A.

[1] NATURE, **134**, 1009 (1934).
[2] *Amer. Mineralogist*, **14**, 228 (1929).
[3] *Stahl u. Eisen*, **42**, 617 (1922).
[4] Annual Institute of Metals Lecture, Amer. Inst. Min. Eng. (1936).
[5] *J. Amer. Chem. Soc.*, **52**, 4268 (1930).
[6] NATURE, **131**, 877 (1933).
[7] Fischbeck and Salzer, *Metallw.*, **14**, 733, 753 (1935).

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## Hooke and his Editors

PROF. E. N. DA C. ANDRADE is to be congratulated in the interpretation of some of the more difficult passages in the manuscript Diaries of Robert Hooke (NATURE, March 7, p. 378). I hope that he may be equally successful with the entry for Dec. 28, 1689, which I have tentatively transcribed "DS com Mard to Counts".

But Prof. Andrade begins with the statement that Dr. Gunther "considers himself aggrieved" that Mr. Robinson was allowed to publish the part of the Diary belonging to the City of London. The reverse was the case. I was very pleased that anyone, and especially Mr. Robinson, should have secured permission to transcribe and publish it. Mr. Robinson, however, had himself informed me that permission to publish was not being given to him, but to the Royal Society, and Prof. Andrade can find evidence for this in a letter from the Guildhall Librarian to *The Times* of February 15 last year. I was aggrieved in 1930 because the Guildhall Librarian refused me permission to have a copy of the Diary made so that I could study it in Oxford, and I have been told that similar applications for studying the original manuscript are to be refused in future.

Still more misleading is Prof. Andrade's continuation, "it behoves us to examine a little Dr. Gunther's claim to have a right to be the editor of anything pertaining to Hooke". I have never made any such claim: on the contrary, I have invited others to edit his work. I have expressed indignation that his original manuscript materials should have been kept for so many years unknown and unknowable both to scholars and to the general public. Concealment happened in several ways: by part of his Diary being catalogued under the name of another author; by the binding of its pages in a wrong chronological order so that the first page, initialled by himself, came in the middle of the volume; by the refusal of owners to permit his manuscripts to be copied.

Through delay in publication, many valuable years have been lost and, what is even more regrettable,

a scrapbook containing most important items relating to Hooke has been broken up and dispersed, with loss of some of the contents. Earlier publicity would have averted this calamity.

In 1930 I desired to assist Mr. Robinson to issue his work, and to this end I wrote to the Carnegie Institution of Washington. In reply, the secretary wrote that the Institution could not provide him with the financial assistance he required and added: "We are interested in knowing of the issue of your edition of Hooke's Life and Works in four volumes . . . it is of course quite evident that the circumstances of such publication should be given adequate consideration in connection with any proposal or arrangement for issue of an edition of the Hooke Diary". (Dec. 29, 1930.)

It may be worth mentioning that a printer's proof copy of my transcript was submitted to the authorities at the British Museum, who used it for rearranging the leaves of the original Diary, and reported that they had not detected any serious discrepancies in the text. This verdict encouraged me in the belief that the advantages of proceeding with the publication would be greater than those of further delay.

R. T. GUNTHER.

Museum of the History of Science,
Oxford.
March 14.

I AM glad to add Dr. Gunther's congratulations to the many others which I have received on my review, but, unlike my private correspondents, he seems to have misread what I wrote much as he misread what Hooke wrote. What was in question was not my interpretation of "some of the more difficult passages", but Dr. Gunther's own failings as an editor. I note that Dr. Gunther does not traverse a single one of my corrections, and I have a further long list of elementary blunders.

If Dr. Gunther does not consider himself aggrieved that Mr. Robinson was allowed to edit the Guildhall Diary, he is singularly unfortunate in the expression of his thoughts. Concerning this Diary he states in his preface to the British Museum Diary: "Had the permission to make a copy been granted to me when requested, the Royal Society would not have been put to so great an expense, the Public would have had the complete Diary in their hands four years ago, many of the outstanding architectural problems would have been solved, the text now printed would have been more correct, and the whole work would have been accessible by a single index". His distinction, in the second paragraph of his letter, between the Royal Society and the Royal Society's librarian is ingenuous. He apparently considers that the Society can act without human agency and edit diaries of its own mere motion. In view of this delicate distinction, it is remarkable that he should confuse between permission to make a copy so that he could study it in Oxford, and permission to do what he states in the preface he desired to do, namely to "add a transcript to this edition of Hooke's Collected Works". If Dr. Gunther is so liable to confuse things totally different, it is scarcely surprising that librarians should go warily with him.

In the third paragraph of his letter Dr. Gunther raises the question of concealment. The British Museum Diary, which is the one now edited by Dr. Gunther, was miscatalogued and unknown. It was discovered in the Museum by Mr. H. W. Robinson, a fact which has never, to my knowledge, been disputed (see NATURE, 126, 244; 1930: "part of a diary recently discovered in the British Museum by Mr. H. W. Robinson. . . . The record . . . was thought to be the diary of James Petiver, an apothecary friend of Hooke. Mr. Robinson has been able to prove that it was written by Hooke"). Dr. Gunther has forgotten to mention this fact both in his present letter and in his preface to the Diary in question. In the face of his statement that he has invited others to edit Hooke's work, it seems strange not only that he should never have asked Mr. Robinson whether he, Mr. Robinson, desired to edit the manuscript which he had discovered, but also that he should have left it to a third party, who had discovered the matter by inquiry at the Museum, to inform Mr. Robinson that Dr. Gunther had the work nearly ready for publication. It may be added that Mr. Robinson had then for some time been at work on a photostat copy of this diary which he possesses, and that a large part of it was already transcribed when he learnt of Dr. Gunther's activity.

Mr. Robinson informs me that he knows nothing of Dr. Gunther's having written to the Carnegie Institution on his behalf, and that Dr. Gunther never consulted him before doing so. Perhaps Dr. Gunther's letter to the Carnegie Institution was as unfortunately worded as his preface, and the authorities of the Institution did not understand from it that Dr. Gunther was trying to assist Mr. Robinson. From the single sentence which Dr. Gunther quotes from the Institution's reply, it would look as if Dr. Gunther had been urging that the Institution should support his efforts to get the Guildhall Diary included in the Guntherian edition. It is particularly surprising that Dr. Gunther should have tried to obtain financial assistance for Mr. Robinson, behind his back, and should be so indignant when the Royal Society actually provided financial assistance. Why is it proper that the Carnegie Institution, which has no connexion with Hooke, should provide the money, and improper for the Royal Society to do so? Or is it possible that Dr. Gunther's remark in his preface, "the Council of the Royal Society has, however, made a charitable grant of £100 to the worthy firm of Messrs. Taylor and Francis, printers, towards *their* expenses in printing a work, the copyright of which is claimed by the Guildhall Librarian" is really a note of approval of the grant? Dr. Gunther is so unfortunate in his wording.

I hope that the British Museum will deal with Dr. Gunther's suggestion that the Museum authorities gave his gallimaufry their blessing. For my part I am content to take my leave of Dr. Gunther with the request that, if he ever intends to help me by writing letters on my behalf, he will first inform me of his intentions and secure my permission.

E. N. DA C. ANDRADE.

## Conservation of Momentum in the Process of Positron Annihilation

IT is well known that when positrons are annihilated, γ-rays with quantum energy of about 500 ekv. are emitted. This seems to prove that annihilation occurs with a loosely bound electron as a partner of the disappearing positron, the process involving mainly low energy positrons. Klemperer, using a coincidence method, was able to show that the annihilation is really accompanied by the simultaneous emission of two quanta. Our experiments were designed to test

whether these two quanta are really emitted in opposite directions.

For this purpose a source of positrons was disposed between two pairs of photon counting tubes. Two counters were placed on each side of the source in order to double the probability of detecting the quantum. To increase the sensitivity to $\gamma$-rays the counting tubes were coated inside with lead 0·2 mm. thick. Two runs were made: the first with the distance from the source to the centres of the nearest counters of each pair being 3·5 cm., and the second 2·5 cm. The ratios of the number of quanta coming across each pair of counters to the whole number emitted by the source were 1/18 and 1/13 respectively.

In each run measurements were taken first with both pairs of counters lying in the same plane with the source. This was followed by control measurements with one pair of counters rotated around the source through 90° from the initial position (*J-position*). Radio-phosphorus obtained by bombardment of aluminium with $\alpha$-particles (500 mc. radon tube) was used as a source of positrons. After 10 minutes' irradiation, the aluminium sample was put into a brass tube (2·5 mm. walls) and coincidences between the two pairs of counters were counted during 3-minute intervals. The resolving power of the amplifying and coincidence-selecting circuit was $2 \times 10^{-6}$ min.

The results obtained in these measurements are given in the accompanying table.

| | Number of spontaneous kicks in one pair of counters (3 min.) | Number of kicks in one pair of counters in the presence of the positron source (3 min.) | Observed number of coincidences (3 min.) | Number of chance coincidences and coincidences due to cosmic rays (3 min.) | Expected number of coincidences (3 min.) |
|---|---|---|---|---|---|
| *Run* 1 | | | | | |
| Correct position | 510 | 935 | 4·7 ± 0·47 | 1·3 ± 0·2 | 5·7 ± 0·5 |
| *J*-position | 490 | 890 | 2·8 ± 0·6 | 2·7 ± 0·75 | 2·5 ± 0·3 |
| *Run* 2 | | | | | |
| Correct position | 516 | 1095 | 7·6 ± 1·0 | 1·1 ± 0·3 | 6·5 ± 0·7 |
| *J*-position | 510 | 870 | 2·6 ± 1·0 | 3·6 ± 0·6 | 2·7 ± 0·3 |

Data in the last column were obtained by a computation based upon a direct measurement of the efficiency of the counters used. This was done by comparing the number of positrons emitted by the source (about $1 \times 10^{4}$ per minute) with the number of annihilation quanta recorded by the counters.

The efficiency of a pair of counters was found to be about 1/80. A correction of 20 per cent for the absorption of the $\gamma$-quanta in the brass surrounding the source and in the walls of the counters was allowed for in this computation.

Analysing the data given in the above table, one is led to the following conclusions:

(1) In the process of positron annihilation there is really an emission of two quanta in opposite directions, as required by the law of conservation of momentum.

(2) As in our experiments (Run 1) only those pairs of quanta could be recorded in which the angles between both quanta were in the range 180°–150°, it can be deduced that positron annihilation occurs at energies lower than 80 ekv.

A. I. ALICHANIAN.
A. I. ALICHANOW.
L. A. ARZIMOVITCH.

Physico-Technical Institute,
Leningrad. March 15.

## Dissolved Carbon Dioxide and the Ripening of Tomatoes

THE phenomenon of climacteric rise in respiration of ripening fruits is not fully understood. Blackman and Parija[1] explained the rise in respiratory activity in apples on the assumption that in the senescent stage a lowering of "hydrolysis-resistance" occurs leading to a greater production of effective substrate for respiration. Kidd and West[2] have attributed the initial increase in carbon dioxide output during senescence to the action of some "protoplasmic factor". Gustafson[3] has demonstrated that the rate of respiration is very greatly influenced by the $p$H of the cell-sap, lower values of $p$H being usually associated with higher rates of respiration, and in a later communication[4] suggests that the climacteric rise is probably due to a lowering of $p$H of the cell-sap.

In the course of some biochemical studies on ripening in tomatoes, the data obtained indicated that increasing amounts of carbon dioxide accumulate in the fruit tissue during ripening. Evidently in massive structures like ripe tomatoes the superficial tissues offer a great resistance to the diffusion of gases. In view of the above, it occurred to us that the climacteric rise in ripening tomatoes may, in all probability, be in part due to either (1) the establishment of a steep gradient between the carbon dioxide inside the fruit and that in the outside atmosphere, or (2) a lessened resistance of the superficial tissues to the diffusion of gases. To elucidate this point, the carbon dioxide dissolved in the fruit sap and the ratio carbon dioxide to oxygen were determined at regular intervals during the stages of ripening and senescence.

Fruits were submerged in boiling 95 per cent alcohol in a closed container[5] placed in a bath the water in which was heated to 90° C., and the dissolved carbon dioxide in the sap was removed by evacuation[6]. The carbon dioxide evolved was trapped in caustic soda and titrated against standard acid. The respiratory quotient (R.Q.) was measured by enclosing the material in air-tight respiration chambers, the gaseous samples removed from which were analysed from time to time by means of an adaptation of Haldane gas-analysis apparatus[7]. The respiration chamber was maintained in a water bath at a temperature of 27 ± 0·2° C. The values obtained both for dissolved carbon dioxide and the R.Q. are presented in the accompanying table.

| Colour of the fruit | Carbon dioxide liberated (ml. (N.T.P.)/kilo/hr.) | Dissolved carbon dioxide (ml. (N.T.P.) per kilo) | R. Q. |
|---|---|---|---|
| Green | 17·7 | 19·7 | 1·11 |
| " | 19·3 | 20·3 | 1·08 |
| Yellow-green | 20·3 | 20·1 | 1·07 |
| " " | 26·7 | 21·7 | 1·01 |
| Green-orange | 30·3 | 26·2 | 1·00 |
| " " | 29·2 | 27·1 | 0·99 |
| Orange-red | 27·3 | 30·6 | 1·01 |
| " " | 20·7 | 33·3 | 1·23 |
| Red | 13·9 | 37·9 | 1·27 |
| " | 11·7 | 37·1 | 1·29 |

*From the data it is evident that considerable* amounts of carbon dioxide accumulate in the fruit tissue during ripening, and that the ratio of carbon dioxide to oxygen starts with a value somewhat

higher than unity, comes down to unity during the climacteric phase, and again rises gradually to 1·29. The suggestion is made (1) that the process of senescence in tomatoes is initiated by the accumulation of increasing amounts of carbon dioxide in the fruit tissue; and (2) that during senescence the resistance offered by the superficial tissues to the movement of gases—carbon dioxide outwards and oxygen inwards—is lessened, thus augmenting not only the rate of carbon dioxide production but also that of oxygen intake. The causes underlying this increased facilitation of gaseous exchange during ripening naturally suggest themselves as a sequel to this investigation.

B. N. SINGH.
P. B. MATHUR.

Benares Hindu University.
March 3.

[1] Blackman and Parija, *Proc. Roy. Soc.*, B, **103**, 412 (1928).
[2] Kidd and West, *Proc. Roy. Soc.*, B, **106**, 93 (1930).
[3] Gustafson, *J. Gen. Physiol.*, **2**, 617 (1920).
[4] Gustafson, *Plant Physiol.*, **4**, 349 (1929).
[5] Willaman and Brown, *Plant Physiol.*, **5**, 535 (1930).
[6] Maquenne, *C.R.*, **119**, 100 (1894).
[7] Singh and Mathur, "An Adaptation of Haldane's Gas-Analysis Apparatus" (in the press).

## Rate of Growth of *Cardium edule*

IN September 1932 the New Brighton (Wallasey) Corporation began an excavation of the sandy foreshore near high-water mark, which was completed and filled with sea-water in May 1933 to form an artificial marine lake. Water is retained in the lake by a sea-wall, which is, however, covered on good spring tides (that is, 29 ft. or more), when the water in the lake is refreshed and partially renewed. The bottom of the lake was originally sand, but had acquired a considerable deposit of mud by February 1935, when the water was run out for removal of encroaching blown sand. At this time, the cockle, *Cardium edule*, was found in considerable numbers (33–459 per sq. metre), as determined by M. Davies, E. Norman, G. E. Williams, P. E. Travis, K. C. Fulton and one of us (J.H.O.) in the sand and mud in the exposed bed, the cockles having entered the lake after the final filling on May 9, 1933.

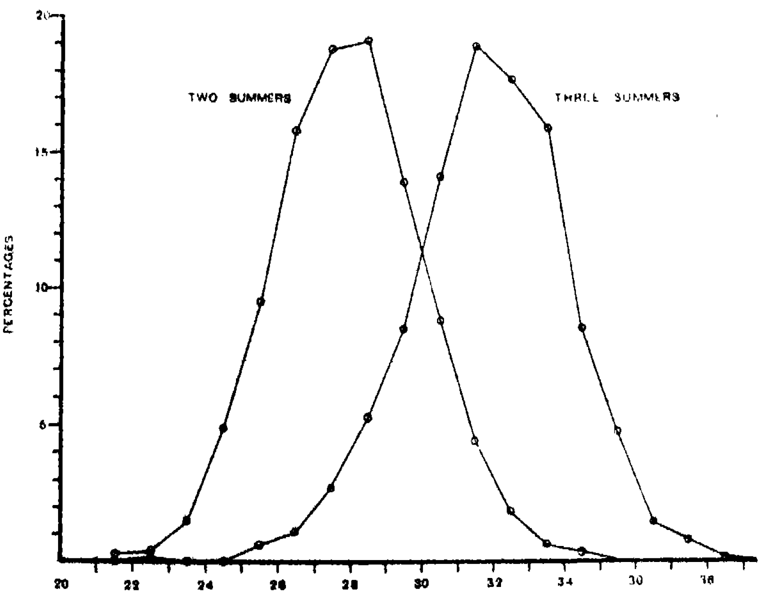


FIG. 1. Percentage length distribution in mm. groups of 1119 *C. edule* taken at random from New Brighton Marine Lake, March, 1935, aged two summers, and 1004 random *C. edule* from the same situation February, 1936, aged three summers.

It was found that the cockles were all of small size, and gave the size distribution for two summers' growth shown in Fig. 1, having mostly one good winter ring, but in many cases additional rings best interpreted as disturbance rings[1]. In addition to this group, only occasional seed cockles of the 1934 year had survived. In February this year (1936) the lake was again emptied and samples of the cockles (which ranged from 32 to 110 per sq. metre) gave the size distribution curve shown in Fig. 1 for three summers. The increment in growth in length in the third summer is mainly about 4 mm. The bivalves now show two good winter rings, but many also again show the small disturbance rings. No seed cockles of the 1935 year have yet been found, and appear to be absent.

There can be no doubt that at least the bulk of the cockles represents a heavy spatfall in 1933, which survived in the newly formed lake, and offers the result of a large-scale fortuitous experiment on the rate of growth of this useful economic mollusc; from the high tidal level of the lake, the uniformity of samples and wide distribution in high concentration of *C. edule*, it is improbable that any other than small seed cockles have been washed into it, for example, on high spring tides. The failure of spatfalls in 1934 and 1935 may be due to absence of spat, but more likely to the failure to survive of such spat as fell in the lake from a variety of causes, among which predatory attacks by crabs, *Carcinus maenas*, and fishes, and the unfavourable environmental conditions (for example, silty muddy bottom, decreasing purity of water) are probably important. It is interesting that fifty per cent of the cockles were of legal size[2] after two summers' growth, but in poor condition in February 1936.

The survival of *C. edule* in this peculiar habitat, that is, totally immersed, is noteworthy, and the size attained is of special interest in comparison with that found by one of us in a contemporaneous experiment (begun in 1933) with a perforated box fixed on the natural cockle beds in the middle of Morecambe Bay[3]. In both habitats the legal size (that is, retained on $\frac{13}{16}$–$\frac{3}{4}$ inch square hole respectively) was attained in about fifty per cent of the population in two summers, and in almost the entire population in three summers. Comparison of the material from the two localities confirms their similarity.

Complete recovery of a depleted bed may therefore occur in three summers and partial recovery in

two summers with survival of a good spatfall. The New Brighton material has considerable scientific value and will be discussed along with that of greater value from Morecambe Bay in detail in the future.

L. E. BUNTING.
A. ESLICK.
J. W. JONES.
J. H. ORTON.

Department of Zoology,
University of Liverpool.
March 9.

[1] J. H. Orton, *Mar. Biol. Assoc.*, 14, 251 (1926).
[2] J. H. Orton, Superintendent's Report, Lancs. and Western S.F.C., March, 1935.
[3] J. H. Orton, *James Johnstone Memorial Volume*, Liverpool, p. 97, 1934.

## Number of Chlorophyll Molecules acting as an Absorbing Unit in Photosynthesis

IN view of Gaffron and Wohl's[1] general discussion of the photosynthetic mechanism of the green plant, the following unpublished, supporting experiment, carried out last spring at Harvard by W. A. Arnold and me, is of interest.

We measured manometrically the photosynthesis (oxygen produced) per flash of light by a thin suspension of the green alga *Chlorella pyrenoidosa*[2]; source, neon discharge tube; spectral region 6250–6950 A.; 1 flash $= 10^{-4}$ sec.; 15 flashes per sec. Thus the Blackman (temperature sensitive) reaction was eliminated[2], the mean lifetime of which at 23·5° C. is 0·02 sec.; also, carbon dioxide was not a limiting factor. Assuming the average quantum to correspond to 6500 A., we studied the yield per flash as a function of quanta per flash.

(1) At 99 per cent light saturation, not more than 1 in 100 chlorophyll molecules absorbed 1 quantum per flash, that is, the probability of an absorption is $10^{-2}$. The probability of four consecutive absorptions by one chlorophyll molecule is therefore $(10^{-2})^4 = 10^{-8}$. If we assume that four consecutive absorptions are necessary to reduce one molecule of carbon dioxide, then, since there were *circa* $10^{16}$ chlorophyll molecules present, it should have taken a minimum of one year to produce 1 c.mm. of oxygen under the conditions of our experiments*. Therefore, since four quanta are necessary[3] to reduce one molecule of carbon dioxide, we must postulate the existence of a mechanism which can reduce a particular carbon dioxide molecule with quanta absorbed by different chlorophyll molecules.

(2) Let $M$ be the fraction of the maximum photosynthesis per flash, obtained at the energy per flash $E$ (in quanta per cm.$^2$). Experimentally we found

$$\log_e (1-M) = -A \times E \quad . \quad . \quad . \quad . \quad (1)$$

Regarding this expression from the *number of quanta to kill* type of analysis[4], we recognise the left-hand member as the *log survival ratio*. $A$, the slope, is a constant. The linear relationship between *log survival ratio* and $E$ indicates that one quantum 'kills', that is, activates one unit. In other words, the quantum absorbing unit does photosynthetic work after a *single* absorption.

(3) The slope $A$ measures the 'blackness' of the absorbing entity. Because $A$ is determined by the work done, that is, by the number of effective absorptions, we may call it (1) the functional molecular absorption coefficient of chlorophyll, or (2) the absorption coefficient of one photosynthetic absorption unit. The value of $A$ was $9 \cdot 7 \times 10^{-14}$ (cm.$^2$/quanta). This is 360 times greater than the maximum value (6200–7000 A.) of the molecular absorption coefficient of chlorophyll dissolved in ether[5]. Therefore, since the total absorption by intact *Chlorella* cells and by an extract of these cells is approximately equal[6], it appears that more than 360 chlorophyll molecules comprise an absorption unit within the plant. The unit, used in this sense, means a mechanism which makes available the energy of an absorbed quantum; it is not assumed that this is a rigid structure.

Previously, we had found 2,000 to be the minimum number of chlorophyll molecules present per molecule of carbon dioxide reduced per flash[7]. Since four quanta are necessary to reduce one molecule of carbon dioxide, this corresponds to an absorption unit of 500.

* The actual time was about three minutes.

HENRY I. KOHN.

Experimental Zoological Institute,
Drottninggatan-116a,
Stockholm.
Feb. 27.

[1] H. Gaffron and K. Wohl, *Naturwiss*, 24, 81 and 103 (1936).
[2] R. Emerson and W. A. Arnold, *J. Gen. Physiol.*, 15, 391 (1932).
[3] O. Warburg and E. Negelein, *Z. phys. Chem.*, 106, 191 (1923).
[4] J. A. Crowther, *Proc. Roy. Soc.*, B, 100, 390 (1926).
[5] F. P. Zscheile, Jr., *Bot. Gaz.*, 95, 529 (1934).
[6] H. I. Kohn, *J. Gen. Physiol.*, 19, 23 (1935).
[7] R. Emerson and W. A. Arnold, *J. Gen. Physiol.*, 16, 191 (1932); W. A. Arnold and H. I. Kohn, ibid., 18, 109 (1934).

## Diamagnetic Susceptibility of Heavy Water

MR. F. E. HOARE has directed attention[1] to the divergence in the mass susceptibility values for heavy water found by himself, Cabrera and Fahlenbrach, and Selwood and Frost. The mass susceptibility of deuterium oxide having been determined in this laboratory in connexion with other work, it may be of interest, in view of Hoare's remarks, to record our value for comparison with the values already published.

We find, using a modified Gouy balance[2] which has been calibrated with a number of highly purified organic liquids (benzene, acetone, chloroform) and inorganic salts (sodium chloride, copper sulphate, nickel sulphate and nickel ammonium sulphate) and with pure distilled water, that the mass susceptibility of heavy water is $0 \cdot 637 \pm 0 \cdot 001$ at 20°. Two specimens of heavy water of density 1·1049 and containing 99·2 per cent deuterium oxide were used. It was measured in two different containers, one of which held $4 \cdot 0810 \pm 0 \cdot 0014$ gm. and the other $3 \cdot 7760 \pm 0 \cdot 0025$ gm.; the mean mass susceptibility in the two tubes being respectively $0 \cdot 639 \pm 0 \cdot 001$ and $0 \cdot 638 \pm 0 \cdot 001$ units of $10^{-6}$.

These values when corrected for 0·8 per cent of ordinary water, which is taken as having a mass susceptibility of 0·720 units of $10^{-6}$, give a value for deuterium oxide of $0 \cdot 637 \pm 0 \cdot 001$ and a molecular susceptibility of 12·76 units of $10^{-6}$ on the assumption that $D_2O$ has a molecular weight 20·027. This value is in complete agreement with that of Cabrera and Fahlenbrach.

V. C. G. TREW.
JAMES F. SPENCER.

Bedford College,
London.
March 25.

[1] NATURE, 137, 497 (1936).
[2] *Trans. Faraday Soc.*, Dec. 1933.

## Heavy Water of Crystallisation

IN connexion with the interesting letter by J. Bell[1], we wish to state that we are engaged in measurements of the dissociation pressures of $CuSO_4, 5D_2O$ and other salts containing heavy water of crystallisation, and also intend to study the crystal angles of these compounds. As is well known, measurements of dissociation pressures of salt hydrates, much work on which has been published by one of us, are somewhat difficult, but some preliminary results will shortly be communicated.

J. R. PARTINGTON.
K. STRATTON.

Queen Mary College,
London.
March 31.

[1] NATURE, 137, 534 (1936).

## Relativity Theory and the Universe

SINCE the relativity theory can be adequately interpreted in the space of Lobachevsky[1], may I be permitted to say a few words in connexion with a communication of Sir James Jeans[2].

In the finite space of positive curvature, the number of nebulæ at great distances would increase less rapidly than $x^3$. However, observations made at Mount Wilson "seem to indicate the exact reverse". This would speak in favour of the supposition that space is of infinite dimensions and of negative curvature. The area of the circle with radius $x$ in Lobachevsky's plane is expressed by

$$A = \pi\, sh^2 x = \pi\left(x^2 + \frac{x^4}{3} + \quad . \quad . \quad .\right);$$

that is, it is larger than the area of a circle of the same radius in the plane of Euclid. The volume of the sphere in Lobachevsky's space is given by

$$V = \pi\,(sh\, 2x - 2x) = \pi\left(\frac{4}{3}x^3 + \frac{4}{15}x^5 + \; . \; . \; .\right).$$

This volume increases more rapidly than the cube of the distance, so that if the nebulæ are uniformly distributed in space, the number of nebulæ would also increase more rapidly than $x^3$; and this would agree with the observations made at Mount Wilson.

V. VARIĆAK.

University,
Zagreb. Feb. 21.

[1] NATURE, 114, 820 (1924).
[2] "The Size and Age of the Universe", NATURE, 137, 20 (Jan. 4, 1936).

## Ebulliometric Determination of Small Amounts of Water*

THE sensitivity of the ebulliometric method of determining small amounts of water, which has been applied to measurements of the water content in standard samples of benzoic acid[1], to determinations of the degree of decomposition of organic substances on heating[2], and to measurements of adsorption of vapours on solid metallic surfaces[3], may be considerably increased by the use of the azeotropic mixture *n*-propanol/toluene instead of ethanol/benzene used formerly.

The method[1] is based on the fact that the lowering of the condensation temperature of a binary azeotropic mixture such as ethanol/benzene is proportional to the amount of water introduced into the apparatus. With the aid of the ebulliometer with several sections, it has been found possible to obtain a lowering of 0·033° C. per mgm. of water. This lowering depends on the dephlegmating power of the apparatus and on the nature of the ebulliometric liquid that is used.

Measurements of the lowering of condensation temperature caused by the addition of 1 mgm. of water to different azeotropic mixtures were carried out in the same apparatus. When the ebulliometer was filled with a constant-boiling mixture of ethanol and benzene, a lowering of 0·010° C. per mgm. of water was obtained, but when the azeotropic mixture *n*-propanol/toluene was used, there was obtained a lowering of 0·080° C. per mgm. of water.

The above data prove that the application of the azeotropic mixture *n*-propanol/toluene increases the sensitivity of the method about eight times in comparison with that obtained when the mixture ethanol/benzene is used.

M. WOJCIECHOWSKI.
(Guest Worker, Polytechnic Institute,
Warsaw, Poland.)
National Bureau of Standards,
Washington, D.C.
Jan. 22.

[1] W. Swietoslawski, M. Wojciechowski and S. Mieruik, *Bull. intern. acad. Polonaise*, A, 59 (1935).
[2] W. Swietoslawski, NATURE, 135, 829 (1935).
[3] M. Wojciechowski, NATURE, 135, 830 (1935).

* Publication approved by the Director of the National Bureau of Standards of the U.S. Department of Commerce.

## Kinetics of a Bimolecular Association in Benzene Solution and in the Gaseous State

FOR the further development of the theory of reaction kinetics and polymerisation in the condensed state, it is important to compare the rate of an association reaction, of the type $a + b \rightarrow c$, in solution and in the gas phase. In this communication experiments are reported from which such a comparison is possible.

The example studied is the Diels-Alder reaction between acrolein ($a$) and *cyclo*pentadiene ($b$) to give endomethylene-tetrahydrobenzaldehyde ($c$)[1]. It was found that in benzene solution, as in the gaseous state[2], a homogeneous bimolecular association is involved. The results of the kinetic measurements are given in the accompanying table.

| | Benzene solution | Gaseous state |
|---|---|---|
| Temp. range | 5·7° – 76·5° | 107·9° – 209·8° |
| $k$ (*l.*/gm.-mol.-sec.) | $3{\cdot}3 \times 10^{-4}$ ($t = 40°$) | $3{\cdot}3 \times 10^{-3}$ ($t = 160°$) |
| $E$ (kgm.-cal.) | $13{\cdot}7 \pm 0{\cdot}5$ | $15{\cdot}2 \pm 1$ |
| $Z$ (*l.*/gm.-mol.-sec.) | $1{\cdot}3 \times 10^6$ | $1{\cdot}5 \times 10^9$ |
| $Z_{max.}$ | $5 \times 10^6$ | $4 \times 10^9$ |
| $Z_{min.}$ | $0{\cdot}3 \times 10^6$ | $0{\cdot}6 \times 10^9$ |
| Measurements by: | Wassermann | Kistiakowsky and Lacher[2] |

In the first line of the table the temperature range over which the measurements were carried out is given. The rate constant $k$ was calculated, taking into account all the experiments within this temperature range. $E$ is the activation energy, and $Z$ in the fourth line was calculated from $k$ and $E$ according to the Arrhenius equation $k = Ze^{-E/RT}$. The $Z$ values of the last two lines have been calculated in order to demonstrate the influence of the experimental error: $Z_{max.}$ corresponds to an activation energy 0·9 kgm.-cal. larger, and $Z_{min.}$ to one 0·9 kgm.-cal. smaller than 13·7 kgm.-cal. or 15·2 kgm.-cal.

It will be observed that both the activation energy and the non-exponential term $Z$ are substantially independent of the presence of the solvent.

If $Z$ is split up in the usual way into a steric factor and a collision frequency, then it can be seen that the collision frequency in the gas phase is of the same order as the 'apparent' collision frequency in solution. A full discussion of the experiments reported in this and in a previous note[3] will be given elsewhere.

ALBERT WASSERMANN.

University College,
London.
March 21.

[1] Diels and Alder, *Annalen*, **460**, 119 (1927); Alder and Stein, *ibid.*, **514**, 197 (1934).
[2] Kistiakowsky and Lacher, *J. Amer. Chem. Soc.*, **58**, 123(1936).
[3] NATURE, **137**, 497 (1936).

## Velocities of Ultra-sonic Sounds

A SHORT time ago Pitt and Jackson[1] measured the velocities of ultra-sonic waves at the temperatures of liquid air and liquid hydrogen, using a vibrating quartz plate as a source. When an attempt was made to continue the experiment in liquid helium, it was found impossible to get the plate to oscillate vigorously; this led to the suspicion that quartz might show an anomaly in its piezo-electric effect at the temperature of liquid helium.

Experiments have now been carried out by both statical and dynamical methods to test this point; the piezo-electric effect was measured at room temperature, the temperature of liquid air, and at various temperatures from 14° K. down to 4·2° K.

The constant at liquid air temperature was found to be 1·3 per cent less than that at room temperature; this decrease agrees with that reported by Onnes and Beckman[2]: "Thus we may conclude that the cooling from 290° K. to 80° K. causes a decrease of 1·2 per cent in the piezo-electric modulus. A further cooling from 80° K. to 20° K. causes a much smaller change. . . . The importance of this result is perhaps that the change in the piezo-electricity by cooling to low temperatures seems to take place chiefly above the temperature of liquid air."

In our experiments a further reduction in temperature to 4·2° K. produced a reduction of 12·4 ($\pm$ 0·7) per cent, the greater part of this reduction occurring between 5·5° K. and 4·2° K. This result is remarkable since we should expect the elastic content of the quartz to be increased.

E. F. BURTON.
A. PITT.
D. W. R. MCKINLEY.

McLennan Laboratory,
University of Toronto,
Toronto.
Feb. 19.

[1] Pitt and Jackson, *Canad. J. Research*, 12, May, 1935.
[2] Onnes and Beckman, *Leiden Comm.*, No. 132f (1912).

## Points from Foregoing Letters

THE presence of 3–5 per cent of carbon dioxide in the air prevents or alleviates the untoward effects of a low oxygen content (8–9 per cent) on brain stem reflexes and also on vision, muscular co-ordination and mental processes, according to experiments by Prof. E. Gellhorn. The results are interpreted as being due to an improvement in respiration and circulation which leads to a better oxygenation of the brain.

Photomicrographs of bismuth crystals showing 'slip' deformation following upon compression are submitted by Dr. H. J. Gough and H. L. Cox, who point out at the same time that deformation by twinning is more frequent.

When positrons are annihilated (by combining with electrons), two quanta of energy are emitted in opposite directions as required by the law of conservation of momentum, according to experiments reported by Prof. A. I. Alichanian, A. I. Alichanow and L. A. Arzimovitch. The positrons were obtained from radio-phosphorus produced by bombardment of aluminium with alpha particles.

Prof. B. N. Singh and P. B. Mathur find that during the ripening of tomatoes considerable amounts of carbon dioxide accumulate in the fruit tissues. They suggest that the process of senescence is initiated by the accumulation of carbon dioxide, and that the accumulation in its turn is favoured by the greater oxygen intake and carbon dioxide production due to the greater permeability of the superficial tissues.

Curves showing the distribution in the size of cockles after one and two summers' growths in an artificial marine lake at New Brighton (Wallasey) are given by L. E. Bunting, A. Eslick, J. W. Jones and Prof. J. H. Orton. The rate of growth of the continuously submerged cockles is comparable with that observed experimentally under normal tidal conditions and shows that the legal size is reached by about half the shells in two summers.

Measurements of the oxygen liberated by a green alga in intermittent light, made by W. A. Arnold and H. I. Kohn, are reported by the latter. It appears that the absorption unit within the plant is equivalent to about 500 chlorophyll molecules, and that quanta absorbed by a number of such units are pooled in order to reduce one molecule of carbon dioxide. The term unit does not imply a rigid structure.

Using a modified, carefully calibrated Gouy balance, Dr. V. C. G. Trew and Prof. J. F. Spencer find that the mass (diamagnetic) susceptibility of heavy water is 0·637 at 20°, in agreement with the results of Cabrera and Fahlenbrach.

The fact that the number of nebulæ increases more rapidly that the cube of the distance is readily explained according to Prof. V. Varićak, if one uses Lobachevsky's geometry, according to which there are two parallel lines to a given line, meeting it at infinity, and hence a line has two distinct points at infinity and not one only as in ordinary geometry.

Dr. M. Wojciechowski reports that in detecting small amounts of water from its effect upon the boiling point of constant boiling (azeotropic) mixtures, a higher sensitivity is obtained by using *n*-propanol and toluene instead of an alcohol-benzene mixture.

The rates of combination of acrolein and *cyclo*pentadiene in the liquid and in the gaseous state (at various temperatures) are compared by A. Wassermann. He concludes that the reaction in both cases is bimolecular and homogeneous, and no chain reaction is involved; consequently it is possible to estimate the collision frequency in solution.

# Research Items

## Excavations at Tall Chager Bazar, 1935

The results of the excavations of the British Museum and the British School of Archæology in Iraq, conducted by Mr. M. E. L. Mallowan at Tall Chager Bazar during 1935, are briefly outlined by Mr. R. D. Barnett in the *British Museum Quarterly*, 10, 3. The plain of the Upper Habur River corresponds in part to the kingdom of Mitanni. After a preliminary reconnaissance in 1934–35, the mound of Tall Chager Bazar, typical of the district about thirty-five kilometres south of Nisibin, and once an important road junction, was selected for excavation. The mound was found to be formed solely by human occupation and to consist of fifteen layers. It was abandoned about 1500 B.C. It has not yet been identified with any historical site known by name in the records. The topmost and latest level, dating from 2000 B.C. to 1600 B.C., contained solidly built houses of Babylonian type. In one room, possibly a kiln, were clay models of horses, which recall the fondness of the Mitannians for horse-breeding. The pottery, highly polished black and a coarse painted ware, is rare but known elsewhere as Hurrian. Levels II–IV contain well-built houses with a surprising number of child burials under the floors. Level V, 3000 B.C.–2500 B.C., contained houses much destroyed, but below them were rich graves containing bronze daggers, silver beads, etc., which show direct connexion of trade with southern Mesopotamia and resemble objects from the Royal Tombs of Ur. Previous to this the hill had been continuously deserted from the close of the rich prehistoric civilisation, characterised by the 'Tel Halaf' ware recently investigated at Arpachiyah. It is here developed through six habitation levels, in which the first use of metals was achieved. Here was found the earliest known cylinder seal. On virgin soil was the highly polished black pottery ornamented with white-filled incised markings hitherto known only from Sakje-Gözü, north-east of Aleppo and Ras Shamra and resembling that from Knossos. It belongs to the end of the stone age.

## Sinkyone Festivals

The Sinkyone (Kaikomas) are an Athabascan tribe living in southern Humboldt and north-western Mendocino counties, California, to whom two visits were paid in 1928 and 1929 by Miss Gladys Ayer Nomland (*Univ. California Pub. Amer. Archæol. Ethnol.*, 36, 2). Their territory extends from the Pacific Ocean eastward to the Nongatl, Lassik and Wailaki western boundaries, while the southern boundary adjoins Kato and coast Yuki and the northern boundaries adjoin Mattole. Their culture is closely allied to that of the surrounding Athabascans and to the general non-Athabascan type of culture of northern California. One of the most interesting features here recorded is that of the first-salmon rites. During the salmon run, usually lasting about two months, the tribe camped on the banks of the streams. In fishing, unlike hunting, there were no restrictions against women taking part or on sex-relations. Any-one might catch the first salmon; but after its capture, the shaman began the ceremony. The first-salmon rite is a characteristic north-western trait, the southern extension of which meets the Californian culture in Sinkyone territory. This is probably the farthest southerly occurrence of the rite. The prayer with which the shaman begins the ceremony is clearly the same as that of the characteristic first-acorn ceremony, the older acorn formula having been transferred to the newer introduced salmon ceremony. After the first prayer, the shaman danced around a small fire for a short time and then ceremonially scaled and cleaned the salmon with a special obsidian knife, split it open, and roasted it on hot coals at the side of the stream, where it was brought out of the water. The shaman tasted the first morsel, then each person present must taste a bit of the flesh to ensure the increase of salmon for the next year, as well as personal and tribal safety.

## Fauna of the Marquesas

The human population of the Marquesas has fallen from more than 50,000 to about 2,000 owing almost entirely to introduced diseases, especially tuberculosis, and yet a surprisingly small number of the protozoan diseases of the tropics has occurred there. In a survey of the non-marine invertebrate fauna of the islands (excluding the insects), A. M. Adamson shows that large numbers of endemic species are known amongst the Arthropods and Mollusca (*Bernice P. Bishop Museum Occasional Papers*, 10, No. 10; 1935). But while the degree of endemism of land snails in many central Pacific Islands is almost 100 per cent, relatively fewer species of this group would appear to have evolved on the Marquesas, where out of 92 species of land and fresh-water snails 72 (about 78 per cent) are endemic. On the whole, it is apparent that there is a general affinity between the Marquesan fauna and that of the islands to the south-west, Cook and Society Islands and in lesser degree Austral Islands, and thence with the Indo-Malayan fauna. The non-marine invertebrates, however, do not show any direct relationship with those of Hawaii, except as regards one genus of spiders and some of the mites. There is also little evidence of American influence in this island fauna.

## Nematodes of the Belgian Coast

Dr. J. H. Schuurmans Stekhoven, jun., in his "Additional Notes to my Monographs on the Free-living Marine Nemas of the Belgian Coasts. I and II written in collaboration with W. Adam and L. A. de Coninck, with some Remarks on the Ecology of Belgian Nemas" adds several new species and new records to his former lists (Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Mémoire No. 72, 1935). The study of many mud and sand samples afforded the opportunity for important ecological studies in which several localities are compared. It is found by the author, that, generally speaking, the richness in quantity of the nemic population depends on the amount of mud and detritus present in the habitat. There is a great deal of shifting due to tides, which apparently explains the comparative richness of the nematode fauna often found in shell sand, for the worms swept by waves find a hold between the

sand particles; but the food is scarce here, and most of the species do not reproduce but move to the more fertile and muddy places for feeding and breeding. A survey of each sample studied shows the number of nematodes present and the composition of the soil, with mention of the more important animal or plant life occurring there. The largest number of individuals, consisting of twelve species, occurred in a sample from Zeebrugge "in yellow-brown sulfur-ion containing mud with an enormous number of *Cyanophyceæ*".

### A Simple Test for Seed Viability

DR. KOZO HASEGAWA, of the Forest Experimental Station, Imperial Household, Asakawa near Tôkyô, claims to have had very reliable results in seed testing, with a colour reaction with a one per cent solution of sodium tellurate (*Japanese J. Bot.*, 8, No. 1; 1936). A darkening of the living embryonic tissues takes place within forty-eight hours (at 16° C.) and this colour change then remains constant. It is claimed that the depth and extent of the colour change can be correlated with the vitality of the embryo. The author further states that no damage is done to the vitality of the embryo by this treatment. This simple method of testing viability will undoubtedly be given a trial in many laboratories where seed viability is a problem of first importance.

### Light Intensity and Sporulation of Fungi

MANY species of fungi which produce spores liberally in the open air are poor spore-formers in artificial culture. Mr. W. A. R. Dillon Weston has shown that in the fungi *Helminthosporium avenæ* and *Alternaria solani*, paucity of sporulation is due to lack of sufficient light intensity (*Trans. Brit. Mycol. Soc.*, 20, Pt. 2, January 1936). The account follows a previous announcement in these columns (NATURE, 131, 435; 1933) that sporulation was induced by irradiation with a quartz mercury vapour lamp. Further experiments have shown that it was the relatively high intensity of the visible part of the spectrum which produced the effect, and that light below a wave-length of about 400 mμ actually did not induce sporulation. Cultures of *H. avenæ* exposed to high light intensity spored about eighteen hours after irradiation, and continuation of such exposure increased the pigmentation of the fungus.

### Decay of Timber

THE *Transactions of the Botanical Society of Edinburgh*, 31, Part 4, 1935, contains an interesting discussion of the main fungus agencies associated with the decay of timber in buildings, especially under Scottish conditions. It is pointed out that the ravages of different species have been lumped together frequently as due to 'dry rot', *Merulius lachrymans*. In connexion with this organism it is apparently necessary to distinguish between *M. domesticus*, only known on sawn timber, and *M. silvester*, which occurs in the forest. There have been no records of the latter in Scotland until it was found recently on Corsican pine in East Lothian. *Coniophora cerebella* has frequently been confused with dry rot, but the fructifications are different and this fungus only attacks house timber under very damp conditions, when, however, there is some evidence it may pave the way for a subsequent attack of true dry rot. Species of *Lenzites*, *Lentinus* and *Trametes* are also described as occasionally found in building timbers. *Trametes serialis* needs higher temperatures probably than usually prevail in Scotland, but was found in joists around hot-water pipes in an unventilated space.

### Wetting Agents in Insecticides and Fungicides

THE full effective action of insecticidal and fungicidal spray solutions is only obtained when the solution thoroughly wets the insect or fungal surface, and this is frequently secured by the addition of wetting agents or 'spreaders', a procedure which may involve difficulties where combined direct and protective washes are used. Evans and Martin (*J. Pom. and Hort. Sci.*, 13, 4, 261) have made a survey of various wetting agents, the amount of spray retention on several standard surfaces being determined by the use of an apparatus designed to apply known amounts of spray solutions. Wetting properties are defined by the ability of the liquid to form a persistent liquid-solid interface when excess of liquid is drained from the surface, and the various physical properties examined, namely, spray retention, area of spread, contact angles and surface tension, all arrange the materials tested in the same general order of wetting activity. A classification is made of wetting agents on a structural basis, and it is suggested that the behaviour of materials of similar molecular structure may possibly be predicted by certain properties determined in the laboratory.

### The Peru Coastal Current

THE Peru coastal current which sometimes bears Humboldt's name has been the subject of much speculation and investigation since Humboldt in 1802 attributed it to cold water from Antarctic latitudes. In a lecture to the Royal Geographical Society on March 9, Mr. E. R. Gunther discussed recent investigations in this current made by the R.R.S. *William Scoresby*. Humboldt's suggestion was queried by Bougainville in 1837 and replaced in 1844 by de Tessan's theory of the upwelling of lower layers. Of this there is no doubt. Maury in 1844 applied the law of deviation due to the rotation of the earth, and Witte in 1880 showed how a northerly current must lag to the west as it reaches latitudes of higher rotation, and thereby induce lower layers of water to well up and take its place. These processes Mr. Gunther admits, but he combats the conception that the surface layers are derived from the coast by offshore winds. This idea was contemporaneous with that of the trade wind belt girdling the earth, which is now known to be untrue; the prevalent winds between lat. 5° and lat. 40° S. blow more or less parallel with the coast. However, the effect is produced by aspiration, that is, by surface drift away from the coast owing to the south-east winds in the open ocean. Mr. Gunther also discusses the small inshore counter currents in the nature of cyclonic eddies. As regards nomenclature, he prefers the name Peru, and argues that Humboldt's name should be dropped since it was associated with an abandoned theory.

### Pre-Cambrian Rocks of North America

DETAILED knowledge of the geology of the Lake Superior region has been greatly augmented since the official monograph on the area was issued by the United States Geological Survey in 1911. In Professional Paper 184 of this Survey, C. K. Leith, R. J. Lund and A. Leith have assembled the new

information and presented a revised map, with cross-sections, based on the details of some 150 local maps. The result is a most welcome review of the Pre-Cambrian rocks of one of the world's standard areas. The most noteworthy of the new correlations suggested are (*a*) the correlation of the major iron-formations of the Mesabi, Gogebic, Marquette and Menominee ranges as of Middle Huronian age; and (*b*) the correlation of the iron-formations of the Cuyuna, Iron River, Florence and Crystal Falls districts as of Upper Huronian age. While the Knife Lake series is regarded as probably pre-Lower Huronian, the possibility of its being Lower Huronian is not overlooked. Three great periods of granite intrusion are recognised—Laurentian, Algoman and Killarney. The last of these is defined as cutting the Keweenawan series (550 million years), but there is also a post-Huronian granite of much greater age (800 million years) than the Keweenawan which is probably the equivalent of the type Killarnean granites of Killarney. This difficulty is clearly brought out by recent lead- and helium-ratios. If the post-Keweenawan granites could be given some other name than Killarnean much confusion would be avoided.

### The Trent River Bore

AN account by the late H. H. Champion and R. H. Cockran of the bore or 'eagre' which forms in the River Trent has recently appeared (*Proc. Roy. Soc.*, A, March, 1936). Observations were made of the water-level throughout the tidal cycle, at several stations on the river, and a detailed examination was made of the rapid rise of level which constitutes the bore. The tide in the Humber estuary was available from Admiralty tide tables. The observations allowed the authors to draw profiles of the water surface at short intervals, showing the formation of the steep-fronted eagre at a point a few miles from the mouth of the Trent, and its subsequent progress upstream at a speed of about 10 m.p.h. The amplitude of the front increases during the next twenty miles of the progress, and then falls off. The data provide material which could be used for a theoretical analysis of the phenomenon.

### Effects of $\gamma$-Radiation on the Chick Embryo

IN a paper contributed to *Acta Radiologica* (16, 719; 1935) Mr. C. W. Wilson, of the Strangeways Laboratory, Cambridge, discusses some effects of $\gamma$-radiation upon the developing chick embryo. Previous investigations had dealt with the action of radiations on chick tissues grown *in vitro*; in the present communication the work is extended to the more complex conditions of growth in the presence of a circulation. Earlier work had indicated that the sensitivity of the chick embryo, as measured by the lethal dose, was dependent upon the age of the embryo at the time of exposure. In the present experiments embryos of 1–6 days' incubation were submitted *in ovo* to uniform $\gamma$-radiation from 145 mgm. radium element. The results obtained with exposure for 3 hours suggest that this exposure is somewhere near the border line which permits the complete recovery of an irradiated embryo, with subsequent hatching. Exposures of longer than 3 hours were invariably fatal; shorter exposures, such as 2 hours, permitted a practically normal development in a large number of cases. It was found that radiosensitivity decreased regularly for the first 3 days of incubation, decreased more rapidly from 3 to 5 days and then remained fairly stationary. There appears to be a maximum dose of radiation from which embryos may recover and hatch, and it is suggested that this dose probably produces some irreversible changes through the blood circulation.

### Artificial Radioactivity of Thulium

THE rare earths have been repeatedly tested for induced radioactivity, with the sole exception of thulium. Elisabeth Neuninger and Elisabeth Rona (*Wien. Anz.*, 72, 275 (1935). *Mitt. Inst. Radiumforsch.*, 375*a*.) have examined a thulium preparation which contained, according to spectroscopic analysis, 7·5 gm. $Tm_2O_3$, 2·3 gm. $Y_2O_3$, a minute quantity of cassiopeium and traces of erbium. The induced activity of thulium caused by bombardment with neutrons, retarded in paraffin, has a half-period of several months or more and is very intense. The half-value thickness for the electrons is 0·15 mm. in aluminium. The other rare earths contained in the preparation were tested separately for artificial radioactivity, the results showing that besides values already known, ytterbium has a faint activity with a half-period of about 40 hours.

### Strength of Synthetic Resin Materials

RAPIDLY growing experience in the preparation and manufacture of the materials grouped under the designation 'plastics' has led to their use in increasingly important applications, a notable example being that of the material for air screws. The advantages from the manufacturing point of view which enable these materials to be made up into intricate forms with a good finish are offset by their low ultimate strength, limit of proportionality and Young's modulus, and as a result they are generally more favoured for ornamental purposes than for parts upon which serious stress is imposed. In the case of air screws, cotton fabric is impregnated with phenol formaldehyde resin, and it is not a little surprising that two such dissimilar materials—one pliable and extensible, the other extremely brittle—should combine to produce one having an ultimate tensile strength of 14,000 lb. per sq. in. with a proportionality limit of 2,000 lb. per sq. in. Owing to the rapid disintegration of the material after this last figure has been reached, Messrs. Aero Research, Ltd., of Duxford, Cambridge, have undertaken an investigation into the possibility of raising its value. In this interesting commercial research it was established that the properties of the combination depended upon the proportion of fabric present and upon the degree to which the fabric is initially in tension and the resin in compression. A tensile load can be applied with safety up to the point at which the initial compression in the resin is eliminated, after which Hooke's law ceases to apply and creep, due to failure of resin and fabric to hold together, begins. Experiments showed that the stress at which departure from Hooke's law occurs is that at which the resin was hardened, and therefore as most commercially obtainable materials are treated at a pressure of one ton per square inch they begin to show creep at about 2,000 lb. per sq. in. Working from this basis, improved methods of manufacture have been devised, and by suitable proportions of fabric and resin, combined under the right conditions, a material having a proportionality limit of 6,500 lb. per sq. in. has been obtained, at, of course, the expense of reduced ultimate strength.

# The Egyptian Exploration of the Red Sea

By Dr. Cyril Crossland, Biological Station, Ghardaqa, Red Sea District

A SIX weeks' cruise in the northern Red Sea was undertaken by the University of Egypt and the Fisheries Research Department with the R.E.R.S. *Mabahith* last winter, as a preliminary to a much more extended exploration planned for the present winter, but this has been postponed owing to the political and financial situations. The main items of our programme were:

(1) The structure of the Red Sea Rift.
(2) Hydrography.
(3) The bottom fauna.

Sagh Mahmud el Meligi, of the coastguards service, was in command of the ship. Lines of soundings *transverse* to the axis of the sea were recorded by Lieut. A. M. Badr of the Royal Yachts, and also off the slopes of certain reefs and islands. The geology of islands was undertaken by Nasri Mitri Shukri under the superintendence of G. Andrew of the University of Egypt. Chemistry was undertaken by Abd el Fattah Mohamed, assisted by Ibrahim Eff. Abu Samra of the Fisheries Research Laboratory and others, who were continuously busy on board ship and whose results are still being worked out. In biology, I was assisted by Dr. Mohamed Kamel el Sabi of the Fisheries, who took charge of the biology on those cruises on which I was unable to be present, with the assistance of H. A. F. Gohar, my assistant in the Biological Station, and Abd el Halim Nasr of the University. Abd el Hafiz Eff. Radwan, instrument maker of the University, was indefatigable in keeping the sounding machine in order, a quite essential help.

The Rift Valley structure of the Red Sea needs special methods of investigation. In the first place, the *Mabahith* is fitted with a Hughes echo sounder, which records the depth beneath the ship every two seconds, drawing a curve representing the form of the bottom as the ship passes above it. In this sea this curve is scarcely ever flat, even the plains which do occur generally showing undulations two to three hundred feet high. The two main features brought out by the sections run transversely to the longer axis of the sea are: (1) the steps by which the bottom descends to its greatest depth, such as would be expected on the sides of a faulted valley and which were postulated as foundations for the Barrier reefs by me in 1907[1]; (2) the occurrence of steep submarine hills, some of which reach the surface, such as the well-known Brothers Islets and Daedalus reefs on which lighthouses have been placed. As there is no trace of vulcanism in this part of the Red Sea, these hills must be block mountains resulting from the rifting, as the Brothers and such islands as Zeberged certainly are. These features are illustrated in Figs. 1 and 2, in which the vertical scale is about five times the horizontal, but it is to be borne in mind that echo sounding reduces the slope, and that abrupt summits of scarps, if they occur, are rounded off.

It was hoped that samples of the original rocks of the valley might be obtained, as was done by the John Murray Expedition off the faulted south coast of Arabia, but the whole bottom is buried in a yellow mud. Bottom samples are still under examination, but riddling gives quantities of pteropod shells, etc., or, in shallower water, broken lamellibranchs. Consolidation of this material, especially where it is coarser, near the tops of slopes, is frequent, resulting in either loose friable masses or hard rock. Consolidation was found even in the deep area near the Arabian reefs in lat. 25° 20′, for which we propose the name "Mabahith Deep", at 1,200 fm. and similar depths.


FIG. 1. Section from a point off Ghardaqa, long. 27° 18′ N., lat. 33° 51·9′ E., to the south end of Shadwan Island, showing submarine hills, which, in shallower water, would bear coral reefs. The larger eastern hill bore dead pieces of the reef coral *Montipora*, the encrusting foraminiferan *Gypsina* and Lithothamnioneæ. The latter was found as deep as 52 fm., below which only sand and calcrete were found. The vertical scale is about five times the horizontal.

The irregularity of the bottom, and in shallow water its rocky nature, made dredging and trawling difficult, and frequently resulted only in torn nets, even in the case of the triangular dredge with its specially strong net. Some successful hauls were made, but much of our collecting was done by the

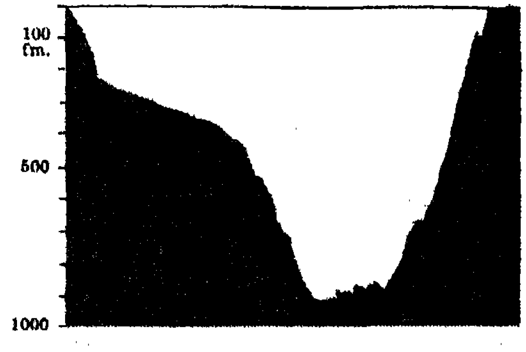


FIG. 2. Section across the deep trough in the Gulf of Aqaba at lat. 28° 50′ E., showing a fault shelf on the west and large irregularities even at the greatest depth. The vertical scale is about five times the horizontal.

grab, which was successful in depths so great as 600 fm. We find that the fauna in deep water consists of few species sparsely occurring, and that no area, even in the Mabahith Deep, is free from life. It will be of great interest to discover the origin of this fauna, since, in the present age, the deep fauna of the Indian Ocean is cut off by the shallow sill at the straits of Bab el Mandab, and the temperature of the bottom waters of the Red Sea, 20° C., is so

much higher than that of similar depths in the oceans. The numerous large quantities of mud obtained by the grab were almost, but not quite, devoid of life.

The coral cappings on those of the submarine hills which reach the surface or nearly so would seem to be similarly situated ecologically to the atolls of the Indian and Pacific oceans, and, as coral growth round their rims is in full vigour, it was expected, in accordance with the theories of growth of atolls, that their slopes would be covered by fallen coral debris. This was found to be the case only to a quite inconsiderable extent; indeed throughout our exploration, recognisable coral debris is confined to quite shallow water. It was also surprising to find that several shoals examined by the grab are not, as would be expected in a sea so full of coral growth, growing towards the surface, but, though small living corals are present, are evidently in process of decay, as shown by the dead and decayed masses of coral brought up: boring organisms are much more abundant in these masses than in the surface reefs. The decay appears to be rapid, since our soundings are deeper than those recorded only sixty years ago. This state of things corresponds with surface reefs in this neighbourhood, some of which are in full vigour, others stationary or in decay; some shoals visible from above are covered completely with growing corals, on others are few or none. Our knowledge of coral ecology is still very imperfect. Between the reefs down to 50 fm. at least, the bottom is in many places rough and rocky, the nature of the rock being at present unknown. Dead and partly living corals only were secured.

The southern part of the Gulf of Aqaba was also explored. The difference between this and the Gulf of Suez is well known; against the average depths of 30–40 fm. of the flat-bottomed Gulf of Suez we have in Aqaba soundings up to 700 fm., but by making courses transverse to the Gulf we discovered a deep trough 900–1,000 fm. deep, well over to the eastern side. This narrow gulf, only about 14 miles wide, thus has a depth nearly as great as that of the Red Sea, which itself is deeper in proportion to breadth than any other. From this depth of water the mountains rise sheer, making one of the most wild and desolate coasts in the world, beside which the deserts and mountains of the Gulf of Suez are a mild and smiling landscape. The maritime plain, so characteristic of the Red Sea shores, where it is generally up to 20 miles wide, is here almost absent, but represented even on some of the most abrupt mountain shores by patches of sedimentary rocks clinging to their bases just above water-level. The immense quantities of alluvial gravels which must have resulted from the denudation of the hills in the past disappeared before the Miocene sedimentary rocks were laid down, showing that the rifting of the valley was in two stages, separated by considerable geological time.

[1] Crossland, C., *J. Linn. Soc.*, **31**, 26 and 284.

# Methods of Estimating Underground Oil Reserves

MR. V. BILIBIN'S report on his method of estimating underground oil reserves has been accepted by the Organisation Committee of the International Geological Congress, and will be considered at the seventeenth session of that Congress to be held in Moscow in 1937. In the meantime, it is being circulated by the Committee with the view of obtaining criticisms and further contributions to this somewhat complicated problem of accurate assessment of oil reserves.

According to Mr. Bilibin's method, the first step is to divide up a general geographical map of the country to be surveyed into various groups of areas by means of colours, the division being based on corresponding available data and geological reasoning. It is suggested that the total surface area be divided into groups of areas as follows: those which have already been exploited for oil; those which, tested by deep drilling, are known to be economically oil-bearing; those considered potentially economically oil-bearing as a result of geophysical and prospecting work; those for general geological reasons considered favourable but which have not been tested, or have been insufficiently tested; those for which no estimate of reserves is available; and those considered as non-oil-bearing.

The total surface area of each of the first four groups is used as a basis of calculation. Distinction is then made between the different types of reserves available in each group. Five categories of reserves are suggested, namely, prepared reserves obtainable from producing wells; explored reserves obtainable from new wells in a prospected horizon and within its fixed boundaries; possible reserves obtainable either from parts of prospected horizons, the boundaries of which have not been fixed, or from discovered, but insufficiently tested horizons; supposed reserves obtainable from the first two groups of areas from horizons proved to be oil-bearing by geological data, or estimated to be so by geological considerations; and possible reserves obtainable from areas where prospecting has been favourable. Reserves falling within the different categories are then estimated either by a method of relation curves based on initial production, well-spacing and number of wells per horizon, or by a saturation method which is a mathematical calculation of the ultimate product obtainable from a given horizon, dependent on the volume of the bed, porosity, saturation and recovery factors.

It will be noted that in this method of estimating underground reserves of economic importance, only those are included which are obtainable by wells from each horizon by modern methods of exploitation. Those obtained by so-called secondary methods are not included as it is not at present possible to find out definitely to which horizons these methods can be effectively applied; nor are there sufficient data to show how exploitation can be increased by using these methods.

# Utilisation of Tropical Australia

IN discussions relating to white settlement in Australia, reference is often made to the scant population in the Northern Territory in comparison with the dense population of Java, though portions of Java are said to possess similar soil and climatic conditions to the Northern Territory. Sir David Rivett, on behalf of the Commonwealth Council for Scientific and Industrial Research, and with the assistance of the British Consul at Batavia, has made an inquiry into this matter and has been supplied with information by Dr. J. G. B. Beumée, Chief of the Agriculture and Fishery Service, Batavia. Dr. Beumée reports as follows :

"The driest regions of Eastern Java and the Lesser Sunda Islands are only comparable to the more rainy stations from your table [information supplied from Australia]. The rainfall is quite insufficient for an intensive native agriculture. In the district as far as situated on the Islands of Bali and of Lombok, extensive areas are suitable for the growing of paddy, as the rivers from the high volcanoes, which receive much more rain throughout the year, contain sufficient quantities of water for irrigation purposes.

"Only in the dry district of Java where one river brings only sufficient irrigation water, sugar-cane is grown by one European firm, otherwise the scanty native population get a living by cultivating maize, millets, cotton, several drought-resisting beans, and locally by an extensive raising of cattle and horses. The climatic conditions are not suitable for introducing agriculture along Western methods."

Java and Madura are about twice the size of Tasmania, approximately 50,000 square miles in area, and contain about thirty-eight million inhabitants who are pressing on the means of subsistence. This density, which averages about 750 to the square mile, is exceeded in the northern and fertile portion of the island. Several regions have a dry climate and most of these are situated on the lesser Sunda Islands (and the eastern end of Java).

Eight districts are indicated where the rainfall varies from about 50 to 90 inches per annum, but with a period of relatively dry months similar to the conditions in the Northern Territory and parts of coastal Queensland.

In a subsequent letter, dated March 2, 1936, Dr. Beumée furnishes a table showing the population in these dry areas, so far as practicable, and writes as follows :

"The influence of the abundance of irrigation-water on the denseness of the native population is very striking. The districts 2 and 3 on the lower southern slopes of the volcanoes on Bali have the densest population by far. Since very long times the natives there have made and kept in perfect order the necessary arrangements for the distribution of the water as to obtain the highest profit from irrigating their paddy-fields.

"District 8 also has a rather dense population (the average for the whole of Java and Madura being 310 per square kilometer) which population as a matter of fact can get their living there only by the availability of irrigation water."

Some of these are supplied with water by irrigation from the volcanoes of Bali, and they carry a large population. But in other districts the population per square mile varies from 65 to 200, whereas in the dry districts which have irrigation it rises to 750.

It is obvious that even with this enormous population pressure, the dry areas cannot be densely peopled. In Northern Australia, apart from coastal Queensland where the rainfall is not as good and there can be no irrigation, anything like a dense population is out of the question—especially when the population pressure is limited to less than seven million people.

# Copelata of the *Terra Nova* Expedition

SUPPLEMENTING his report on the Doliolids (see NATURE of July 21, 1934) Prof. Garstang now deals with the Appendicularians (Report on the Tunicata. Part 2, Copelata. Prof. W. Garstang and Dr. Elizabeth Georgeson. British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. 4, No. 8, 1935. British Museum (Natural History), price 1*s*. 6*d*.). These are from the Atlantic, South Pacific, north-west of New Zealand and the Antarctic, and are all Oikopleurids. Out of 2,000 specimens from thirty-four stations, not less than 1,900 belong to the two species *O. longicauda*, dominating the warm waters of the Atlantic and South Pacific, and *O. valdiviæ*, dominating the Antarctic waters. *O. longicauda* is of world-wide value as a warm-water indicator, and its dominance in the Atlantic and South Pacific samples and absence in the antarctic stations bears this out.

In the recent report of the Tunicata from the Great Barrier Reef (F. S. Russell and J. S. Colman, *Scientific Reports*, 2, No. 7) the authors find also that two species predominate, one being *O. longicauda*, the characteristic species for the warm-water region of the Atlantic, Pacific and Indian Oceans, abundant both in coastal waters and the open sea, and *O. rufescens*, which is a true tropical form, scarcer in the open ocean than in the coastal region, and more frequent in the Indian Ocean than in the Atlantic. In *O. valdiviæ* a very small proportion are mature before the final stage of growth, and the records suggest a short breeding season late in the Antarctic summer. A new species of *Folia* (*F. gigas*) is created for a single specimen from the Antarctic, taken in a net towed (nominally) at a depth of 80 metres, differing in several anatomical points as well as in much greater size from Lohmann's *Folia gracilis*. This had probably drifted into Antarctic waters from the tropical Pacific. The *Stegosomas* are now recognised as essentially epiplanktonic and tropical. Three specimens of *Pelagopleura magna* are interesting, and the presence of food-remains in them seems to prove Lohmann's view that it is a natural inhabitant of antarctic deep water, to which it appears to be confined.

# Transformation in the Copper-Gold Alloy, $Cu_3Au$

OF the papers of a theoretical nature read at the Spring Meeting of the Institute of Metals, that by Sykes and Evans on the transformation in the copper–gold alloy corresponding to the composition $Cu_3Au$ will probably be found by most readers to be of the greatest interest. The conclusions reached are as follows.

It has been shown that the general character of the transformation in $Cu_3Au$ is very similar to that predicted by W. L. Bragg and Williams. In particular, the transformation takes place continuously from the critical temperature to very low temperatures, and the equilibrium condition when produced after long annealing is displaced by a change in temperature, that is, the equilibrium is a dynamic one. The authors have found a large change in resistivity at the critical temperature, not previously established, which is in agreement with theory.

The simple hypothesis put forward in order to describe the relaxation to the equilibrium state is inadequate, and it is not yet possible to state whether a formula of the type:

$$\frac{d\theta}{dt} = \frac{\theta - T}{\tau}$$

is an accurate representation of the experimental facts, even if applied to a uniformly ordered structure. Further relaxation experiments on alloys ordered throughout on the same simple cubic lattice are desirable. We should expect a formula of the type

$$\tau = Ae^{W/kT}$$

to hold in any case for relaxation at constant temperature, so that measurements of $\tau$ by both methods, that is, at constant temperature and during cooling, are desirable.

The marked difference in properties of the alloy containing nuclei as distinct from those ordered throughout on the same simple cubic lattice is of considerable interest, and previous work on transformations of this type should be reconsidered in view of these results.

The performance of different samples of the same alloy is accurately reproducible. This is perhaps remarkable in view of the large range of properties which can be obtained by heat treatment, and must be attributed to the fact that the transformation is an intracrystalline phenomenon almost independent of grain boundary effects.

# Educational Topics and Events

LONDON.—The degree of D.Sc. has been awarded to F. D. Miles (Imperial College—Royal College of Science) in regard to twenty-two works on physical chemistry, and the degree of D.Sc. (Engineering) to S. J. Davies, reader at King's College, in regard to six works on internal combustion engines and hydraulics, and seven conjoint papers.

ON August 31–September 12 this year, Harvard will celebrate the tercentenary of its foundation in 1636, when the general court of the Massachusetts Colony voted £400 toward "a schoale or colledge". First named "Newetowne", the name was changed to Harvard in 1639 when John Harvard, an immigrant Puritan minister, bequeathed to the College, on his death, half of his estate (£780) and 260 books. According to Science Service, of Washington, D.C., seventy-five of the world's leading men of science and other scholars will gather at Cambridge, Mass., in a conference seldom equalled in America in respect to distinguished speakers and the breadth of subjects. No less than fourteen Nobel Prize winners will be among those giving addresses; they include Albert Einstein (physics), United States; Niels Bohr (physics), Denmark; Hans Fischer (chemistry), Germany; Arthur H. Compton (physics), United States; Sir Frederick Gowland Hopkins (physiology and medicine), England; Robert A. Millikan (physics), United States; Friedrich Bergius (chemistry), Germany; August Krogh (physiology and medicine), Denmark; The Svedberg (chemistry), Sweden; Otto Warburg (physiology and medicine), Germany; Karl Landsteiner (physiology and medicine), United States; Hans Spemann (physiology and medicine), Germany; E. D. Adrian (physiology and medicine), England; and Werner Heisenberg (physics), Germany. Symposia will be held upon recent investigations in mathematics, astronomy, physics, chemistry, geology and biology, and also on broader problems such as "Factors Determining Human Behavior", "Authority and the Individual" and "Independence, Convergence and Borrowing in Institutions, Thought and Art", which will draw upon the social sciences and humanities.

THE Carnegie Trust for the Universities of Scotland has published this year, in its thirty-fourth annual report, particulars of its seventh quinquennial allocation, covering the period 1936–40, of grants to universities and other institutions for teaching and research. The grants amount in the aggregate to £257,300 for the whole period. This represents about half the Trust's income, the other half being devoted to assistance in payment of class fees of students. Of the £30,000 allocated for grants during the quinquennium to institutions other than universities, one half goes to the Royal Technical College, Glasgow, Robert Gordon's Colleges, Aberdeen, and the Heriot-Watt College, Edinburgh. The three agricultural colleges at those places, the Rowett and Macaulay research institutes at Aberdeen, the Veterinary Colleges at Glasgow and Edinburgh, St. Mungo's College, Glasgow, and the School of Medicine of the Royal Colleges in Edinburgh all come in for grants of £1,000 or more. The allocation was based on recommendations prepared after exhaustive inquiries by a Committee of Visitation. This quinquennial stocktaking and comprehensive review of the needs of the country in the field of higher education and research greatly enhance the importance of the Trust's services. Appended to the report are speeches broadcast in celebration of the first centenary of Andrew Carnegie's birth.

APPLICATIONS for Ramsay Memorial fellowships for chemical research, one of which will be limited to candidates educated in Glasgow, will be considered by the Ramsay Memorial Fellowship Trustees in June. The value of each fellowship will be £250 per annum, to which may be added a grant for expenses not exceeding £50 per annum. Full particulars as to the conditions of the awards are obtainable from the Secretary of the Ramsay Memorial Fellowships Trust, University College, London (Gower Street, W.C.1).

# Science News a Century Ago

### Lardner on the Theory of Railways

AT a meeting of the Royal Society held on April 28, 1836, Lardner read a paper "On Certain Parts of the Theory of Railways; with an Investigation of the Formulæ Necessary for the Determination of the Resistances to the Motion of Carriages upon Them". In the course of his paper, he treated of the motion of trains on the level, on ascending and descending inclines and around curves. He confined himself to the analytical formulæ expressing various mechanical effects of the most general kind. He had, however, he said, made extensive experiments in the last few years, and had procured the results of experiments by others, and had made numerous observations in the ordinary course of transit by railways, and he announced his intention of placing the results of these experiments before the Society later.

### Darwin in Mauritius

ON April 29, 1836, H.M.S. *Beagle* arrived at Mauritius, where she remained until May 9. Darwin in his "Journal of Researches" gave a short account of the island. On May 1, he took a short walk along the sea-coast, finding the country pleasant but without the charms of Tahiti or the grandeur of Brazil. The next day he ascended La Pouce, 2,600 ft. high. "The centre of the island," he wrote, "consists of a great platform, surrounded by old broken basaltic mountains, with their strata dipping seawards. The central platform, formed of comparatively recent streams of lava, is of an oval shape, thirteen geographical miles across, in the line of its shorter axis. The exterior bounding mountains come into that class of structures called 'Craters of Elevation', which are supposed to have been formed not like ordinary craters, but by a great and sudden upheaval. There appears to me to be insuperable objections to this view; on the other hand, I can hardly believe, in this and some other cases, that these marginal crateriform mountains are merely the basal remnants of immense volcanos, of which the summits either have been blown off, or swallowed up in subterranean abysses."

Since England has taken possession of the island, Darwin said, the export of sugar had increased seventy-five fold, while one of the causes of its prosperity was the excellent state of the roads. Although the French residents must have profited by the prosperity, the English Government was far from popular.

### Baron von Ludwig and Sir John Herschel

IN one of a series of "Letters from a Cadet" published in the *Athenæum* of April 30, 1836, the writer gave an account of his visits to Baron von Ludwig and Sir John Herschel at the Cape of Good Hope. The former was a Dutch gentleman of ample fortunes which enabled him "to indulge his taste for natural history, while his enlightened liberality throws open his magnificent gardens to all strangers on the simple condition of sending in their names . . . his garden is that of a philanthropist as well as a philosopher; his fertile mind teems with projects for the improvement of the colony in which he is settled".

The writer had the pleasure of spending the morning with Herschel, finding him engaged in a course of astronomical researches which, he said, had already afforded some most interesting results. "He had made himself universally respected by his amiability, his readiness to assist the distressed, and his anxiety to join in all local schemes of improvement, whether in education, agriculture, commerce or scientific discovery. It is really a touching sight to behold this man, deservedly ranked among the first of his age, leaving an infant school, which has, in great measure, sprung up under his fostering care and influence, to draw up at the desire of the Cape Literary and Philosophical Society, a body of admirable instructions for the gentlemen composing the scientific expedition at present engaged in exploring the pathless wilds of Southern Africa."

### Agassiz and the Geological Society

AGASSIZ (*Notizen a. d. Gebiet. d. Natur. u. Heilkunde*, April 1836), on the occasion of his visit to London, speaks in the following high terms of praise of the Geological Society: "The Geological Society of London is one of the institutions which have been founded on the most liberal principles and by its influence supports everything which even indirectly can contribute to the progress of science. It is to the generosity of the president and council of this society that I have been able to carry out a work in London which would have been impossible without the support and authorization of a society which enjoys a high reputation unparalleled in the history of the natural sciences. As I found that the collections of the three kingdoms possessed an enormous amount of material important for my work I wondered how I could best avail myself of it, and it was only through the liberality of the English men of science that I was able to take away with me the specimens which appeared to throw a new light on fossil fishes. On the application of Messrs. Greenhough, Sedgwick, Murchison and Lyell, I had permission to examine all these treasures in a room at Somerset House, where Mr. Lonsdale, the conservator of the Society's collections, helped me to arrange 2,000 specimens of fossil fish which I had selected from about 8,000 in England, Scotland and Ireland."

# Societies and Academies

### DUBLIN

Royal Dublin Society, February 25. T. J. NOLAN, J. KEANE and P. A. SPILLANE: The chemical constituents of lichens found in Ireland. (*a*) *Ruellia conescens*. (2). The lichen contains atranorin, chloratranorin, diploicin, for which the formula $C_{16}H_{10}O_5Cl_4$ has been confirmed, and a substance closely related to diploicin and having the formula $C_{16}H_{11}O_5Cl_3$. Diploicin is a depsidone containing one methoxyl and one phenolic hydroxyl group, and is most probably derived from the condensation of two molecules of dichlor-orsellinic acid with the elimination of one molecule of carbon dioxide. T. J. NOLAN, J. KEANE and M. MOHAN: (*b*) *Lecanora gangaleoides*. (2). The lichen contains atranorin, chloratranorin, gangaleoidine, for which the formula $C_{18}H_{14}O_7Cl_4$

has been confirmed, and a substance of formula $C_{26}H_{21}O_{10}Cl_3$ containing one methoxyl group and apparently a tridepside. Gangaleoidin is shown to be closely related to diploicin and is a depsidone containing one phenolic hydroxyl, one methoxyl and one carboxylic ester group. T. J. NOLAN, J. KEANE and G. KENNEDY: (c) *Lecanora sordida*. (1). The observations of Zopf concerning the constituents of this lichen are confirmed in certain respects. It contains 4 per cent rocellic acid, a dextrorotatory dicarboxylic fatty acid for which the formula $C_{17}H_{32}O_4$ is confirmed, 0·7 per cent of a mixture of atranorin and chloratranorin and 0·02 per cent of an acid resembling Zopf's thiophanic acid and containing 14·1 per cent of chlorine. J. BELL and W. A. GILLESPIE: The hydrolysis of urea hydrochloride. Determination of the hydrolysis constant of urea hydrochloride in aqueous solution by electrometric methods gave results in agreement with the original values obtained by Walker and Wood, using catalytic methods. J. LYONS and M. O'SHEA: Factors influencing the loss of butter fat in churning. The lesser the proportion of small fat globules in the cream, and the lower the temperature to which the cream is chilled, the more efficient the churning: cream of medium richness, effectively cooled after pasteurisation and agitated in a fairly full container, churns best.

### PARIS

Academy of Sciences, March 16 (*C.R.*, **202**, 885–992). ERNEST ESCLANGON: The abnormal solution of a problem of mechanics deduced from the principle of relativity. DIMITRI RIABOUCHINSKY: Contribution to the theory of gaseous jets. LUC PICART was elected a non-resident member in succession to the late Victor Grignard, and MAURICE NICLOUX a *Correspondant* for the Section of Chemistry. CHARLES PISOT: A characteristic property of certain algebraic integrals. TH. MOTZKIN: Transformations which do not augment the number of variations of sign. PAUL VINCENSINI: Certain series of Laplace. ALFRED ROSENBLATT and STANISLAW TURSKI: The conformal representation of plane domains. W. STERNBERG: The integral equation of the first species. STANISLAW MAZUR and WLADYSLAW ORLICZ: Rational functionals. ARNAUD DENJOY: Homographic groups. V. FROLOW: The movements of the mean level of the sea at Brest and at Marseilles. JEAN LEGRAND: Analysis of the oscillations of the mean annual sea-level at Brest. CHARLES JAEGER: Theory of knocking in forced mains with multiple characteristics. The resonance of the fundamental and the harmonics. PIERRE ERNEST MERCIER and JEAN CROSET: A graphical method of solving hyperstatic systems. F. LINK: The photometric consequences of Einstein's deviation. MLLE. MARIE ANTOINETTE BAUDOT: The new electrodynamics. JEAN LOUIS DESTOUCHES: The electronic nature of light. LA GOLDSTEIN: The shocks of slow electrons in pure oxygen. Electronic affinity. JEAN CAYREL: The Devaux reaction concerning the modification of a superficial film of cupric sulphide by copper. MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: Remarks on the measurement and production of high potentials. A method of absolute measurement is described in which a sphere is charged to the potential to be measured, and a small disk of platinum of the same curvature is lifted by the repulsion, and falls off the sphere. The authors describe the number of thin disks used as a box of weights for potentials. ANDRÉ EGAL and ROBERT CHEVALIER: A meter with compensated thermocouples for measuring the calories given out by a hot water central heating installation. BERNARD KWAL and JACQUES SOLOMON: A consequence of the new non-linear electrodynamics. JEAN SAVORNIN: The theory of diffraction by a metallic screen with a rectilinear edge. MICHEL DUFFIEUX and LÉON GRILLET: A new band of nitric oxide. YVES LE GRAND: Two properties of sources of polarised light. OTAKAR VIKTORIN: The emission of ultra-violet radiation in the Reboul effect. A description of experiments showing clearly that an ultra-violet radiation of a wave-length between 2600 and 2000 A. accompanies the Reboul effect. SALOMON ROSENBLUM: The existence of the $\alpha_2$ line and the decomposition of the magnetic spectrum of thorium C into two series. JEAN AMIEL: Contribution to the quantitative study of the slow combustion of benzene and of some hydrocarbons: The results are shown in curves, and a formula, admittedly empirical, is given which agrees well with the author's experiments. HENRI MURAOUR and ALBERT MICHEL-LÉVY: Metal spectra obtained by waves of shock. MME. MARIE ELISA P. RUMPF: The existence of chlorotitanic acid, $H_2TiCl_6$. The Raman spectrum. RENÉ FREYMANN: The measurement of dielectric constants for very short waves with the aid of a recording apparatus. The accuracy of the apparatus described is of the order of 0·5 per cent. The results of its application to pyrrol and to some amines are given. MARCEL PRETTRE: The influence of pressure, concentration and temperature on the slow oxidation velocity and aptitude to spontaneous inflammation of mixtures of oxygen and normal pentane below 300° C. RAYMOND QUELET: The chloro-alkylation of anisol: the synthesis of vinylanisols. F. BLONDEL and J. BONDON: The manganese of the Siroua (South Morocco) region. LÉON AUFRÈRE: The *Cervus Somonensis* of the National Museum of Natural History. ALBERT ROBAUX: The distribution of the Flysch in the subbetic along the Londa transversal (Andalusia). ARMAND RENIER: The Armorican chain and Varisque chain. Contribution to the study of the inflections of bundles of folds. CLAUDE GAILLARD: A giant bird in the Eocene deposits of Mont-d'Or Lyonnais. The portions found indicate a bird of the size of the black cassowary of Australia. PAUL ROUGERIE: The relation between the solar activity and the daily amplitude of the north-south telluric currents recorded at the Ebre Observatory. EDMOND GILLES: The ultra-violet absorption of cellophane and of plant tissues and organs. RENÉ SALGUES: Leaf cyanogenesis in Photinia. HENRI COLIN and MLLE. ANDRÉE CHAUDUN: The diastatic degradation of the intercellular cement. MLLES. EUDOXIE BACHRACH and MADELEINE SIMONET: Diatoms and blue pigmentation. JACQUES MAWAS: An undescribed epithelial organ, the infra-orbital paraganglion. PAUL BECQUEREL: The latent life of some Algæ and lower animals at low temperatures and the conservation of life in the universe. MME. ANDRÉE DRILHON: Some chemical and physicochemical constants of the internal medium of *Carcinus mænas*. MME. PAULETTE CHAIX and CLAUDE FROMAGEOT: New experiments on the action of sulphur derivatives on the fermentation of glucose by propionic bacteria. THÉOPHILE CAHN and JACQUES HOUGET: The final destination of the glucides in the muscle extracts of normal and diabetic dogs. RAYMOND POISSON: *Dermomycoides armoriacus*, a cutaneous parasite of *Triturus palmatus*.

The structure of the zoospore. ETIENNE SERGENT: The preparation of an active serum against scorpion poison. W. KOPACZEWSKI: The lactogelification of the seric proteins in cancer.

### Moscow

Academy of Sciences (*C.R.*, 1, No. 1; 1936). F. GANTMACHER: Non-symmetrical nuclei of Kellogg. V. KUPRADZE: Dispersion of electromagnetic waves in a non-homogeneous medium. I. I. ISLAMOV and J. M. TOLMACHEV: Colour of corundum. G. M. KOVALENKO: Resistance of gaseous mixtures to electric penetration. N. A. SHISHAKOV: Anomalous structures of fine crystalline silica. K. S. TOPCHIJEV: Action of carbon disulphide on methyl-pyridonimmin. N. TUDOROVSKAJA: Some peculiarities in the variations in the refraction index of glass at temperatures below 300° C. V. I. BODYLEVSKIJ: Concerning traces of the Upper Volga stage in the west Siberian plains. G. C. LAEMMLEIN: The sequence of the deposition of silicates from magma and their crystal grid energies. D. KOSTOFF: Studies on polyploid plants. (11) Amphidiploid *Triticum timopheevi*, Zhuk. × *Triticum monococcum*, L. M. L. KARP: Number and distribution of genes in the third chromosome of *Drosophila melanogaster*, affecting the number of sternital bristles. N. P. KALABUCHOV and L. B. LEVINSON: Effect of low temperature upon trypanosomes (*Trypanosoma equiperdum*) in mammals (see NATURE, Oct. 5, 1935, p. 553). A. N. SVETOVIDOV: A new herring from the Caspian Sea, *Caspialosa caspia salina* subsp.n.

### Rome

Royal National Academy of the Lincei (*Atti*, 22, 181–273) G. SCORZA: Varieties of Veronese. L. PUCCIANTI: Electrical and magnetic inductivity in relation to the new electrical metrology. L. PUCCIANTI: General considerations on magnetic moment and magnetic poles, intensity of magnetisation and susceptibility, and on the corresponding measurements in a system with four fundamental units. G. A. MAGGI and B. FINZI: A question relating to electro-magnetic harmonic waves. G. PALOZZI: Projective linear element and projective applicability of new lattices of ordinary space. S. CHERUBINO: Series of powers of one variable in one algebra. T. BOGGIO: Some systems of differential equations. B. HOSTINSKÝ: Integration of linear substitutions. A. TERRACINI: Projective deformability of rectilinear congruences. G. MARLETTA: Observations on differential projective geometry. G. ASCOLI: Asymptotic behaviour of integrals of linear differential equations of the second order. L. SONA: Translo-circulatory current which attacks a bilateral lamina (2). M. PASTORI: Problem of Clebsch (2). Application to coupled tensors. L. ALLEGRETTI: Measurements of anomalous dispersion of the first doublets of $Sr^+$ and of $Ba^+$. The ratio of the anomalous dispersion coefficients $N_1/N_2$ for the first doublet of the principal series of $Sr^+$ and of $Ba^+$ has the values 2·07 and 2·16, respectively. D. GHIRON: Borovanadates. The existence of two series of borovanadates $2Me^{II}O$, $V_2O_5$, $3B_2O_3$ and $Me^{II}O$, $V_2O_5$, $B_2O_3$ has been shown. M. FRERI: Anomalous action of nitrous acid on hydrazides of organic acids. The action of nitrous acid on the hydrazide of citraconic acid is described. L. PERETTI: Outcrop of pre-Triassic gneiss near Acqui. V. PUNTONI: *Proteomyces infestans*, Moses and Vianna, and its relation to the genus *Trichosporon* (Behrend, 1890).

# Forthcoming Events

### Monday, April 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Lieut.-Colonel D. L. R. Lorimer: "Life in Hunza" (film).

ENGINEERS' GERMAN CIRCLE, at 6.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—E. Kurzel-Runtscheiner: "Das Technische Museum in Wien".

### Tuesday, April 28

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Louis Souchon: "Mauritius".

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Sir Joseph Barcroft, F.R.S.: "The Genesis of Respiratory Movements in the Fœtal Sheep".

INSTITUTION OF CIVIL ENGINEERS, at 6.—E. J. Buckton and H. J. Fereday: "Demolition of Waterloo Bridge".

### Friday, May 1

INSTITUTION OF ELECTRICAL ENGINEERS (METER AND INSTRUMENT SECTION MEETINGS), at 7.—Clifford C. Paterson: "Uniformity as the Gauge of Quality".

ROYAL INSTITUTION, at 9.—Major W. S. Tucker: "Direction Finding by Sound".

# Official Publications Received

### Great Britain and Ireland

Researches published from the Wards and Laboratories of the London Hospital during 1935. 28 papers. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net. [263

The Work of the Heterogeneity of Steel Ingots Committee. Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation reporting to the Iron and Steel Industrial Research Council. Being a Review of the Work to date (December 31, 1935) compiled at the request of the Committee by Dr. W. H. Hatfield. (Special Report No. 12.) Pp. iv+43. (London: Iron and Steel Institute.) [263

Report of the Rugby School Natural History Society for the Year 1935. Pp. 52. (Rugby: George Over, Ltd.) [273

Sea-Fish Commission for the United Kingdom. Second Report: The White Fish Industry. (Cmd. 5130.) Pp. 113. (London: H.M. Stationery Office.) 2s. net. [273

### Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 637: Soils of Orleans County, New York, in their relation to Orchard Planting. By A. T. Sweet. Pp. 32. Bulletin 638: Ten-Year Report of Studies in Child Development and Parent Education. By Ethel B. Waring. Pp. 69. Bulletin 639: Soil, Field-Crop, Pasture and Vegetable-Crop Management for Delaware County, New York. Part 1: Soils and Field Crops, by A. F. Gustafson; Part 2: Pastures, by D. B. Johnstone-Wallace; Part 3: Vegetable Crops, by F. O. Underwood; Part 4: Soil Map and Soil-Type Descriptions, by C. S. Pearson, F. B. Howe and A. F. Gustafson. Pp. 88. Memoir 181: Intercellular Humidity in relation to Fire-Blight Susceptibility in Apple and Pear. By Luther Shaw. Pp. 40. Memoir 182: Wholesale Prices in Cincinnati and New York. By H. E. White. Pp. 42. (Ithaca, N.Y.: Cornell University.) [14

Proceedings of the American Academy of Arts and Sciences. Vol. 7, No. 7: Compressibilities and Electrical Resistance under Pressure, with Special Reference to Intermetallic Compounds. By P. W. Bridgman. Pp. 285–318. 75 cents. Vol. 70, No. 8: The Specific Volume of Steam in the Saturated and Superheated Condition together with Derived Values of the Enthalpy, Entropy, Heat Capacity and Joule Thomson Coefficients. Part 4: Steam Research Program. By Frederick G. Keyes, Leighton B. Smith and Harold T. Gerry. Pp. 319–364. 1 dollar. Vol. 70, No. 9: Philippine Phoridae from the Mount Apo Region in Mindanao. By Charles T. Brues. Pp. 365–466. 1.50 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [14

Records of the Geological Survey of India. Vol. 70: Quinquennial Review of the Mineral Production of India for the Years 1929 to 1933. By the Director and Senior Officers of the Geological Survey of India. Pp. iv+453+lxxvi+7 plates. (Delhi: Manager of Publications.) 6.4 rupees; 10s. [14

Indian Central Cotton Committee: Technological Laboratory. Cotton Research in India: being an Account of the Work done at the Indian Central Cotton Committee Technological Laboratory, 1924–1935. By Dr. Nazir Ahmad. Pp. vi+106+12 plates. (Bombay: Indian Central Cotton Committee.) 2 rupees. [14

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 18–1: How Communities can Help. Pp. vii+77. (Washington, D.C.: Government Printing Office.) 10 cents. [14

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No. 3470 SATURDAY, MAY 2, 1936 Vol. 137

# British Ordnance Maps and their Revision

ON May 28 of last year the Minister of Agriculture and Fisheries appointed a Departmental Committee on the Ordnance Survey, with the following terms of reference:

(*a*) to consider what measures are necessary to accelerate the revision of the Ordnance Survey Maps in order to bring them up-to-date and hereafter to maintain them at a high level of accuracy, while providing for such other public services as are undertaken by the Ordnance Survey Department;

(*b*) to consider what immediate steps are possible in the meantime to revise Ordnance Survey maps to the extent necessary for the purpose of town and country planning schemes;

(*c*) to review the scales and styles of Ordnance Survey maps placed on sale to the public and to recommend whether any changes are desirable; and

(*d*) to review the conditions upon which the reproduction of Ordnance Survey maps is permitted.

Owing to the urgency of certain aspects of the inquiry, the Committee has issued an Interim Report* referring only to matters forming the subject of paragraphs (*b*) and (*d*). The Minister considers these to be of pressing importance in view of the fact that many schemes under the Town and Country Planning Act 1932, and other Acts, are held up because of the absence of up-to-date maps which local authorities are required to submit with their planning projects.

Successive director-generals have repeatedly pointed out, but without avail, the state of disrepair into which the 25-in. plans have been allowed to lapse. In the period of the Great War, this could not be avoided, but since the War it certainly has been a wasteful policy to starve the Ordnance Survey, especially in view of the great changes which have taken place on the face of the country causing the maps to become rapidly out of date. It should have been a period of survey activity, instead of the reverse. Numbers of Acts, culminating in the Town and Country Planning Act of 1932, have been passed in recent years, none of which could be effectively put into operation without really up-to-date maps, yet the means to provide them has been consistently withheld.

According to the Report, 1,400 plans, on the 25-in. scale, require substantial revision before they can be submitted by local authorities with schemes requiring the sanction of the Ministry of Health; while with the existing staff of the Survey not more than two hundred plans could be revised, according to Ordnance Survey standard, before the end of 1937. In order to meet this situation, the Committee recommends that an interim edition of the plans be prepared for the special purpose of town planning schemes, showing only sufficient detail to enable them to be used to illustrate such schemes. They would show new field boundaries, buildings and other physical features but omit new bench-marks, names of new roads and streets and the numbers and areas of 'parcels' in which alterations have taken place since the last edition. These omissions would not impair the eventual completion of the plans according to Ordnance style. It is estimated that the time saved by adopting this method would be one year, and that the whole of the 1,400 plans could be revised by the existing staff sufficiently for town planning purposes by December 31, 1938.

The above plan presupposes the concentration of the whole of the present staff on the interim

* Interim Report of the Departmental Committee on the Ordnance Survey. Pp. 16. (London: H.M. Stationery Office.) 3d. net.

plans, which would have the effect of "causing delay and complicate the normal revision still further". The Committee therefore recommends "that there should be an immediate increase in the establishment of the Ordnance Survey, if the production of plans for town planning purposes is to be accelerated, and normal revision resumed and expedited at the earliest possible moment". By this means the Director-General considers the earliest date by which the immediate demands of the town planning authorities could be satisfied would be June 1938, although some plans would be available before the end of 1936.

The Committee then goes on to consider the application of aerial photography as a means of accelerating map revision. It is satisfied that it is possible in this way to produce an accurate plan with sufficient detail for town planning purposes, as described above, and that the employment of air photography might lead to considerable acceleration in the output of maps.

Mention is made of a recent experiment in this connexion, carried out by contractors for the Ordnance Survey, and to the fact that the photographs failed to cover some portions of the area and that sufficient overlap was not always provided to enable the photographs to be submitted to stereoscopic examination. However, the results showed it is possible to produce from air photographs, without revision on the ground, a revised plan which would meet the requirements of town planning.

We think that in referring to the gaps in the work, and to the lack of necessary overlap in the photographs in the experiment in question, it should have been pointed out that these defects were largely due to the late date at which the contract was placed, whereby many excellent 'photographic days' were lost, and to the insistence on the employment of the auto-pilot, which has not yet reached a stage in development sufficiently advanced to meet the exacting requirements of photographic surveying; otherwise these faults could easily have been made good. We believe that if the next contract, recommended by the Committee, is given early enough in the season and is not hampered by restrictions, air photographs will provide all the information necessary to produce the plans required in a much shorter time than by ground methods.

The concluding portion of the Report deals with the conditions of reproduction of Ordnance Maps, which are Crown copyright, by the public. An appendix contains draft proposals on the subject.

We await with interest the final report of the Committee, especially as to whether the measures it recommends will lead to the adoption of a single projection for the 25-in. map, the basis of all other scales, as explained in NATURE of February 1, 1936, p. 165. We note with surprise that this Committee, which has to deal with highly technical matters, does not contain a single surveyor.

# Essays in the History of Science

**Osiris**

Vol. 1: A Volume of Studies on the History of Mathematics and the History of Science. Presented to Prof. David Eugene Smith on his 76th Birthday (Jan. 21, 1936). Edited by George Sarton, with the cooperation of Prof. R. C. Archibald, Miss B. M. Frick, Dr. A. Pogo. Pp. 777. (Bruges: The Saint Catherine Press, Ltd., 1936.) 6 dollars (to members of the History of Science Society, 5 dollars).

THIS is the first volume of a new series intended to be supplementary to the well-known quarterly journal *Isis*, the organ of the History of Science Society and of the International Academy of the History of Science; the series is to contain the longer articles, each volume constituting a special number, while *Isis* will continue to be a quarterly journal containing the shorter articles, reviews, notes and correspondence. The present large volume is, most appropriately, dedicated to Prof. David Eugene Smith, of Columbia University, New York, the veteran historian of mathematics and author of many other mathematical works. It is a pleasure to see so fitting and worthy a tribute paid to Prof. Smith on the occasion of his seventy-sixth birthday.

At the beginning of the volume, after the dedication by the editor to Prof. Smith, is a very remarkable bibliography of his critical, historical and pedagogic writings. These consist, first, of books, articles and pamphlets, introductions and reviews of which Prof. Smith is the author (508 items); secondly, of books, articles and committee reports edited or translated by him (45 items); and lastly a list of encyclopædias and periodicals

for which he acted as editor or associate-editor (eleven in all, including the "Encyclopaedia Britannica", fourteenth edition, for which he acted as editor of the Department of Mathematics, himself contributing eleven articles). There is added an account of Prof. Smith's very rich library, presented by him to the Columbia University and consisting of printed books, manuscripts, portraits and autographs of mathematicians, medals and medallions, and mathematical and astronomical instruments; it comprises some twenty thousand items in all, collected during more than forty years. To mention only one detail: the printed books comprise more than fifty "Euclids" printed before 1800, and among them are the first printed edition of the "Elements" (Erhard Ratdolt, Venice, 1482), the Pacioli edition of 1509, the Peletarius translation of 1557 and, naturally, the first English edition (the translation by Billingsley, 1570).

The rest of the volume contains thirty-five articles in different languages, English, French, German, Italian and Spanish. The first article, by R. C. Archibald, gives thirty hitherto unpublished letters of James Joseph Sylvester, preceded by a "curriculum" of his life, with dates of main incidents, details of publications relating to his life and works, particulars which have not so far been adequately treated, and finally an account of his poetry. To the letters are added notes containing all necessary information about persons or incidents referred to in the letters. Under the heading of Sylvester's poetry there is a full account of his book "The Laws of Verse . . . exemplified in Metrical Translations", 1870, and there are references to and citations from the poems. Among the titles may be mentioned "Rosalind", "Spring's Debut", "Sonnet to a high soprano accompanying herself on the piano", "Sonnet on being aroused out of an algebraical reverie by a lady", "Sonnet to a missing member of a family group of terms in an algebraical formula".

Of the other articles only a few can be mentioned here. Ettore Bartolotti gives in "L'algebra nella storia della scienza" an outline (as good as could be expected in forty-seven pages) of the history of the subject from its beginnings, including the geometrical algebra of the Greeks, Muhammad ibn Mūsā and Diophantus, down to Bombelli, but finishing with more detailed accounts of algebra in ancient Egypt and Babylonian algebra. This is followed by a very interesting paper of Julian L. Coolidge on "The Origin of Analytic Geometry". In a paper on Muhammad ibn Mūsā, S. Gandz contends that he owed nothing to the Greeks, that his geometry shows no traces of the influence of Euclid but was mensuration practically 'lifted' from an old Hebrew geometry, "Mishnat ha Middot", compiled about A.D. 150, and that the source of his algebra was a native, Syriac-Persian, tradition going back to the Babylonians.

Benjamin Ginzburg writes on the "Scientific Value of the Copernican Induction". Astronomy is further represented by (1) S. A. Ionides on "Cæsar's Astronomy" (a manual of astronomy written by Peter Apian, Ingolstadt, 1540), so called because it was dedicated to "the Cæsars", Emperor Charles V of Rome and his brother, King Ferdinand of Spain; (2) "Thomas Digges and Modern Astronomy", by F. R. Johnson; (3) J. Millás on a forgotten astronomical tract by Juan Hispanus (twelfth century); (4) an article by Ernst Zinner on "Die Tafeln von Toledo (Tabulae Toletanae)". P. P. Wiener writes on "The Tradition behind Galileo's Methodology", J. A. Vollgraaf on "Snellius' Notes on the Reflection and Refraction of Rays", Helen M. Walker on an unpublished hydraulic experiment by Roberval, Frederick H. Setman on "Samuel Morey, a Pioneer of Science in America" (1762–1843), L. G. Simon on "Short Stories in Colonial Geometry", being the story of geometry teaching at Harvard College, Yale College, Columbia College and the University of Pennsylvania in the seventeenth and eighteenth centuries, and J. Pelseneer contributes "une lettre inédite de Newton à Pepys", dated December 23, 1693, on a question in probabilities.

The historian of mathematics will no doubt turn with the greatest interest to the following: (1) Louis C. Karpinski on the first printed arithmetic of Spain, 1482; (2) Prof. Gino Loria on Chasles and the theory of conic sections; (3) a long article of forty pages by the editor, G. Sarton, on Montucla, the historian of mathematics (1725–99), his life and works, with portrait and facsimiles; (4) J. Tropfke on Archimedes' construction of a regular heptagon in a circle; (5) Quido Vetter, "Mathématiques Babyloniennes"; (6) Kurt Vogel, "Bemerkungen zu den quadratischen Gleichungen der babylonischen Mathematik". Tropfke's paper (4) gives a reproduction of a translation by Thābit from the Greek of a treatise which contains a number of interesting propositions relating to the triangle and, at the end, the construction of a regular heptagon in a circle; Thābit expressly describes the work as a book of Archimedes. This particular translation by Thābit was discovered in 1925 by C. Schoy, who died in the same year. The subject of Tropfke's article is therefore no longer new (the construction of the regular heptagon was given in "A Manual of Greek Mathematics", 1931), but it is convenient to have the whole of the treatise reproduced together.

K. Vogel's paper (6) is interesting because it represents a point of view rather different from that of Neugebauer and others who have discussed

the solutions of quadratic equations in Babylonian cuneiform texts of 2000 B.C. or thereabouts. These solutions refer to no rule of solution whatever; they only give the working, and this is consistent with the view of Neugebauer that they correspond to making the necessary substitution of the concrete numbers of the question for the algebraical symbols in our formula for the value of $x$. Vogel points out that the equations solved are generally simultaneous equations in $x$ and $y$ (called 'length' and 'breadth' in the texts) from which $x$ and $y$ are found. The solutions correspond to the two roots of a single equation in one unknown to which they can be reduced, but the working is also consistent with the view that the Babylonians had not carried the theory of the quadratic equation up to the form which it takes in our algebras, but were still at a stage rather more elementary, corresponding to the solutions in Diophantus, and that they had not yet reached the full knowledge of the double solution of a single quadratic according to the sign taken with the radical. On the other hand, the Babylonians knew how to manipulate equations, and they would freely take the opportunity of making a change in a particular variable in order to reduce the equations to what was with them the normal form.

Lastly, we would refer to the article by U. G. Mitchell and Mary Strain on "The Number $e$", distinguishing the stages in its history—the first approximations to its value, the definite recognition of its existence, and finally the proofs of its irrationality (Fourier, 1815) and transcendence (Hermite, 1873). T. L. H.

# The Eskimos: their Past and Future

**The Eskimos**
By Dr. Kaj Birket-Smith. Translated from the Danish by W. E. Calvert; the translation revised by Prof. C. Daryll Forde. Pp. xiv + 250 + 32 plates. (London: Methuen and Co., Ltd., 1936.) 15s. net.

AMONG primitive peoples a unique interest attaches to the Eskimos, because of the severity of the conditions under which they have survived and developed their culture. Unlike the shivering Tierra del Fuegans, they have continued to achieve the maximum of cheerful comfort in the most inhospitable of climates. Even the white man, when he explores their country, must adopt their snow huts, dog sledges, and if he is wise, the essentials of their food and clothing.

No other human race is so thoroughly adapted to the conditions under which it lives. Negroes from the tropics can live and multiply in a cool temperate climate, but to the Eskimo even the latitude of Great Slave Lake is much farther south than he cares to travel, and there is some evidence that he is physiologically adjusted against even a moderately warm temperature. This argues a long sojourn under arctic conditions, and favours the view of Boyd Dawkins and others that the Eskimo ice culture may really be a survival from Upper Palæolithic glacial times in Europe.

The author of this charmingly written volume has had ample contact with the Eskimos. After two expeditions to Greenland, he joined Rasmusson's Thule Expedition in 1921 and sledged across the Arctic to Bering Strait, living an Eskimo's life for two years and making a special study of the inland Caribou Eskimos west of Hudson Bay. His book, while in no way lacking in scientific accuracy, is written simply and can be understood by anybody. It is no mere narrative of his own experiences, but a mature and philosophical account by one who is familiar with every aspect of these fascinating people, from personal contact and from a full knowledge of everything that has been written concerning them. A well-selected bibliography and an index add to its value.

Considering that the Eskimo tribes stretching along thousands of miles of coast-line from Eastern Greenland to Alaska number probably less than 30,000, they have received a quite disproportionate share of attention from anthropologists and others. This can be accounted for partly by the conditions of their life and partly by their temperament, which is lively and self-reliant, whereas the Amerindian is apt to be silent and morose, easily becoming dependent on the white man. The Loucheux Indians, however, on the Arctic Circle in the Mackenzie River basin, have a vivacious temperament like the Eskimos a little farther north, and it becomes an interesting question whether this temperament is a reaction to the arctic conditions or is derived from crossing with their Eskimo neighbours.

Birket-Smith's book is divided into ten chapters. The first deals with the country and its history, especially as regards Greenland, where the Norsemen made contact with the "Skraelings" in the tenth century. Eskimos extended from the Labrador coast into the Gulf of St. Lawrence as late as the seventeenth century, and these people obtained their oil lamps from a soapstone quarry in western Newfoundland. Chapter ii is a study of the physical characters and psychical qualities

of the Eskimos, with a brief reference to their blood groups. A short chapter on the general features of the language and its possible relationships shows how much remains to be done by the comparative philologist. Two chapters are devoted to the struggle for food, which is derived mainly from the reindeer in summer and the seal in winter and spring, although fish, walrus, whales, birds and even berries may on occasion supply their quota. Under the title "Fighting the Cold" the Eskimo clothing and housing are described, the latter including not only the winter igloo but also earth lodges supported by whale bones, as well as stone houses, some of which are prehistoric, and summer tents of reindeer skin.

"The Community" and "The View of Life" are chapters outlining the Eskimos' social and mental outlook. We learn something of their myths and shamanism, and their songs and dances when only the Northern Lights relieve the long darkness. Communism perhaps reaches its extreme form here under conditions in which the margin of safety is always narrow and a surfeit of the village from a successful seal hunt may be followed by a blizzard in which starvation stares at the hunters for a week. Homicide and infanticide are not uncommon.

The most serious chapter for the anthropologist is that on the origin and development of the Eskimo culture. The author accepts as a working hypothesis Steensby's theory that Eskimo culture originated between Hudson Bay and Coronation Gulf, spreading thence east and west, to reach its climax through whale hunting from kayaks in the subarctic regions of Greenland and Alaska. The author postulates not only Palæo- and Neo-Eskimo layers of culture, but also a third, more recent, type derived from an eruption northwards of the Caribou Eskimos, whom he regards as a remnant of the original Proto-Eskimo people remaining in the tundra away from the sea and relying mainly on the caribou herds for their sustenance. The arctic and Palæolithic peoples of Europe and Asia as well as America are involved in this discussion, but no finality can yet be reached in these complex problems.

In a final chapter the present condition of the Eskimos is considered, and especially the serious effects of contact with whites. Eskimos in the Mackenzie delta have their fishing schooners with petrol engines and may even possess gramophone records and radio sets. Many of them are now of mixed blood. In the whole Canadian area the Mounted Police and the Hudson's Bay Company trading posts now reach even the most isolated tribes, trapping for furs has become an important occupation and the rifle has brought a serious lessening of game. It is hoped that the latter will be partly overcome by the recent introduction of reindeer, to multiply as they have already done with great success in Alaska under the rule of the United States. The Eskimos will thus be changed from nomadic hunters to pastoralists. The advantages and disadvantages of a trade monopoly under the Danish Government in Greenland are pointed out, as well as the dangers through which these hardy people, the Eskimos, have yet to pass before they can be regarded as safe from extinction.

R. RUGGLES GATES.

# Warp and Woof in the Theory of Functions

**An Introduction to the Theory of Functions of a Complex Variable**

By Prof. E. T. Copson. Pp. viii + 448. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 25s. net.

STEADILY the regions of mathematics of which we can be ignorant without shame increase in number and extent. With their own researches taking them further and further from common ground, what need the analyst know of central differences, the statistician of the correspondence principle, the geometer of ideals? But common ground remains, though without precise boundaries, and certainly we must all be familiar in some practical sense with the elements of function theory and know something of the most important functions of analysis.

At the beginning of the century, these requirements were distinct. To the theory of functions belonged general processes and comprehensive ideas; properties of algebraic functions and of doubly periodic functions were included, as theorems on integral functions are included to-day, but individual functions were studied in special treatises or special courses of lectures. It was Whittaker who brought the strands together, combining in one brilliant treatise the analytical foundations and somewhat more than the general reader needed to know of the principal transcendental functions. In succeeding editions under dual control, with the foundations strengthened and extended and with the number of individual functions increased, "Modern Analysis" has become more and more valuable to the analyst, but it has long ceased to be everybody's book, and

difficult problems of scope and standard give interest to any treatise that claims to be introductory. Gone are the days when we could suppose that our eyes do the work of our minds, and that somehow we can establish mathematical properties of a 'contour' without giving a mathematical meaning to the word; nevertheless, the ultimate analysis of Cauchy's theorem is a specialist's job. If few of us need Mathieu's functions, still fewer can do without Jacobi's.

Prof. Copson's opening pages do not inspire confidence. His book will never have a reader who has not learnt already the nature of the complex variable, and as Peano realised, the definition as a two-by-two matrix, in which the elements are not independent, needs defence. If it is the matrix that is presented as fundamental, the arbitrary restriction to a peculiar form seems the strangest basis for an algebra; the commutative law is an accident, unless the form of the matrix is deduced from it. That it is not the definition that matters, but the laws of combinations, is said plainly, but this is not an adequate excuse for a change which superficially has nothing in its favour.

After the unfortunate short first chapter, it is a pleasure to find an account of the first principles of the theory of functions that can be recommended enthusiastically. This part of the book is definitely the best introduction that the English reader has to the subject as it is now studied. The discussion of Cauchy's theorem is specially praiseworthy. For a polygonal contour, the arguments are of a kind which recurs perpetually in analysis; their careful application is part of our education, and the proof is in detail. For the extension to a curved boundary, the difficulty is stated and we are referred elsewhere for the investigation. Perhaps it would have been reasonable to attempt the extension to a contour formed of a finite number of straight segments and circular arcs; the relevant topological questions can be answered easily for such a contour, and most, if not all, of the contours used later in the book are of this kind.

The application of residues to the evaluation of integrals, fascinating to every generation of students, is a backwater which we are not allowed to mistake for the main stream. There is a chapter on integral functions, and then one on conformal representation which is in one respect the least satisfying in the book, since there only is there no indication of the nature of the mathematical proof of the underlying general theorem which is enunciated; however, at this stage it is the illustrations that are significant, and the construction of these does not depend on the unproved general theorem. The accounts of special functions, the gamma and hypergeometric functions, Legendre and Bessel functions, and elliptic functions, are excellent in range and treatment; most welcome is the introduction of the Jacobian functions as the functions which, having two simple poles, call as naturally for investigation as the Weierstrassian function. The last chapter is on modular functions, and the book closes with the classical proof of Picard's theorem and Carathéodory's proof of Landau's allied result.

The arrangement of material needs explanation. The maximum modulus principle and Hadamard's three-circles theorem come into the chapter on integral functions; the idea of an asymptotic expansion is encountered as it were incidentally in the chapter on the gamma function, saddle-point integration in the chapter on Bessel functions; the linear differential equation is studied in the chapter on the hypergeometric function. On the other hand, the chapter on conformal representation includes an attempt to make the Schwarz-Christoffel representation of a rectangle on a half-plane intelligible before elliptic functions have been introduced. It is not that the author is at fault. In "Modern Analysis" the warp of general theory is displayed before it is crossed by the woof of applications; experience seems to show that this can not be done on the scale of an introductory treatise.

We are indebted to Prof. Copson for a book that is suitable for a very large number of students, and that has the rare merit of maintaining for the majority the standards that are demanded for the minority. An uncomfortable doubt persists that the book will seem to the learner to be an introduction only to the special functions, not to any general theory. He will see the power of a few processes of analysis; he will not catch a glimpse of regions where analytical processes are of subordinate importance. This may be because, dazzled by Whittaker's success, we have sometimes failed to perceive what it was that he really did. The strands which compose the warp of "Modern Analysis" are by no means all the strands of the theory of functions; there are other strands, the background of designs with which the ordinary transcendental functions have little to do. It was no part of Whittaker's purpose to display these other strands, nor was the title of his book misleading, but it is in a very narrow sense that a book which ignores them is an introduction to the theory of functions.

This is not a mere quibble about titles. An introduction has not the same right as an advanced treatise to be selective and to present a subject in the light only of contemporary activity in research. If we may maintain our metaphor, an introduction should serve not only those who will soon be weavers, but also those who have no ambition except to admire. A mathematical

design is no less beautiful because for the moment the weavers are busy elsewhere. More easily could we maintain that beauty, complete and imperishable, has once and again been achieved. But if beauty that has been perfectly achieved is for that reason never again to be enjoyed, then indeed even in mathematics little is safe from the devouring jaws of greedy time. E. H. N.

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**(1) Metallurgical Abstracts (General and Non-Ferrous)**

Vol. 1 (New Series). Edited by G. Shaw Scott. Pp. vi + 780. (London: Institute of Metals, 1935.) With Vols. 54 and 55 of the 'Journal', £4 net.

**(2) The Journal of the Institute of Metals**

Vol. 56. Pp. 306 + 31 plates. Vol. 57. Pp. 311 + 23 plates. Edited by G. Shaw Scott. (London: Institute of Metals, 1935, 1936.) 31*s*. 6*d*. net each.

(1) THE present volume of metallurgical abstracts constitutes the first of a new series, to be published annually as an entirely separate work with its own index. This replaces the earlier system of binding abstracts as a part of the *Journal* series, with an index covering both abstracts and the Institute's own publications. Some measure of discrimination has been introduced into this volume, in the form of symbols denoting papers describing the results of original research and those giving a critical review of a particular subject. The wide range of metallurgical literature has been covered in the usual comprehensive manner, but we again have to deplore the absence of a list of the journals abstracted.

(2) Twelve papers presented at the annual general meeting of the Institute are included in vol. 56 of the *Journal*, together with Prof. W. L. Bragg's May Lecture on "Atomic Arrangement in Metals and Alloys", in which he dealt with characteristic phase patterns in alloys and changes in orientation brought about by variations in temperature. The papers include the concluding part of a research on unsoundness in aluminium alloy sand castings, a paper dealing with the mechanical properties of wrought magnesium alloys, and a valuable study of type metal alloys. Corrosion and corrosion-fatigue are represented, while other papers deal with the constitution of cadmium-silver and cadmium-tin alloys.

Vol. 57 comprises the papers presented at the autumn meeting of the Institute in Newcastle, when the Autumn Lecture was delivered by Dr. H. W. Brownsdon, on "Metal Melting—its Effect on Quality". A particularly valuable paper in this volume is that by Dr. Maurice Cook, dealing with metal losses in melting brass and other copper alloys. Other contributions include the first part of a research on the interrelation of age-hardening and creep, a study of the properties of some special bronzes, and three papers dealing with the corrosion and protection of magnesium alloys.

**An Introduction to the Study of Physical Metallurgy**

By Dr. Walter Rosenhain. Revised and partly re-written by Dr. John L. Haughton. Third edition. Pp. xvi + 368 + 36 plates. (London: Constable and Co., Ltd., 1935.) 20*s*. net.

THE method adopted in the preparation of the present edition by Dr. Haughton has consisted in the retention of as much as possible of the character of previous editions. The earlier and more elementary part of the book required only slight modification. The chapter on the thermal study of metals and alloys, on the other hand, has been re-written; more attention has been given to ternary diagrams, and all the binary diagrams have been brought up to date. There has also been incorporated a section on the application of the methods of X-ray analysis, contributed by Mr. G. D. Preston. But the latter half of the book, dealing with mechanical testing, plastic deformation, thermal and mechanical treatment and defects and failures in metals, has been left very much as Rosenhain first compiled it in 1914. Very little attention has been given to modern work, while the amorphous metal concept has been retained in all its cumbrous details and assumptions.

**The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland:**

with a Record of Publications issued during Session 1934–1935. Compiled from Official Sources. Fifty-second Annual Issue. Pp. vii + 169. (London: Charles Griffin and Co., Ltd., 1935.) 10*s*.

THIS invaluable reference book has similar format and contents to those of previous issues. The number of societies has again increased during the past year, and these are arranged in fourteen sections according to the subject of their interests. Under each society is given its postal address, etc., list of officers, membership, time and place of meetings, publications and any other important information. All necessary details have been obtained from the officials of the societies and institutions concerned, and this makes the volume all the more authoritative and reliable. No university, research or technical library can afford to dispense with this compilation of useful information.

**A Manual of Practical Anatomy:**

a Guide to the Dissection of the Human Body. By Prof. Thomas Walmsley. Second edition. In 3 Parts. Part 1: The Upper and Lower Limbs. Pp. viii + 376. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THE second edition of this manual of dissection maintains the standard of brevity combined with clarity which was the essential feature of the first edition by the distinguished professor of anatomy in the Queen's University of Belfast. The book has been slightly enlarged by the addition of some exercises in the making of measurements which are used in clinical practice, and by the growth of the sections dealing with surface markings in the living subject.

The illustrations are as simple as is compatible with accuracy, and the radiographs are chosen with extreme care.

# Sensitising Dyes and their Use in Scientific Photography*

By Dr. C. E. K. Mees

ONE of the problems to be encountered in the early days of photography was that photographic materials were not sensitive to the spectrum in the same way that the eye is. Whereas the normal eye is sensitive to the colours of the spectrum from violet through blue, green, yellow and orange to red, the early photographic plates were sensitive only to the ultra-violet, violet and blue.

In 1873, H. Vogel, of Berlin, found that some collodion dry plates possessed sensitivity in the green portion of the spectrum, and he traced this green sensitivity to the presence in the emulsion of a yellow-red dye. Vogel got similar effects with other dyes which, on this account, were later called sensitising dyes or sensitisers, and he came to the conclusion that when a dye acted as a sensitiser in this way, the region of the spectrum for which it was effective corresponded approximately to the absorption band of the dye. Thus a dye which absorbed green light would render a photographic plate sensitive to green. This fundamental relationship underlies all work on sensitising, and it is worthy of attention that Vogel grasped this truth immediately in spite of the fact that his emulsions were very slow, his dyes probably impure and, at best, weak sensitisers, and his apparatus primitive.

Vogel recognised that the dyes which acted as sensitisers for silver bromide must not merely stain the collodion or gelatine in which the silver bromide was imbedded but must also actually be adsorbed on to the surface of the silver bromide particles. Thus the energy which they absorbed could be transmitted in some way to the silver bromide. Vogel's results were at first subjected to a great deal of adverse criticism, and even ridicule, many other workers being unable to confirm his results. But Becquerel in 1874, and then Waterhouse in 1875, were able to support his discovery.

The first sensitising dye to attain any general use was eosin, which sensitises collodion emulsion strongly for the yellow-green. After the introduction of gelatine dry plates, J. M. Eder suggested the use of erythrosin in the place of eosin, and this was generally adopted for the production of the so-called 'orthochromatic' plates, and was almost the only dye used in commercial manufacture before 1906.

Shortly after the beginning of this century, attention was directed to the dyes belonging to the 'cyanine' group. In 1856, a dye known as 'cyanine' had been made by Williams from impure quinoline, but although it had a beautiful blue colour, it was very fugitive to light. Williams's cyanine had been used by Vogel in his early experiments and was considered a useful sensitiser for the orange-red, but it caused fog and spotty patches on the plates.

In 1883, another dye made from quinoline and related to cyanine was discovered, and in 1902 this dye, known as 'ethyl red', was tested by Miethe and Traube for sensitising power, and was found to give good green sensitivity without the tendency to fog characteristic of cyanine. Ethyl red belongs to a group of dyes known as the isocyanines, which are synthesised by the treatment of a mixture of quinaldine and quinoline quaternary salts with an alkali.

At the time that Miethe and Traube described the sensitising power of the simple isocyanine, ethyl red, E. König of the Hoechst Works of Meister, Lucius and Brüning, was synthesising a number of *iso*-cyanines, which were placed on the market under trade names, such as Pinachrome, Orthochrome *T*, Pinaverdol, etc., these being made from substituted quinolines and quinaldines, and by 1904 it was clear that the cyanine dyes of the new type were much more suitable for use in photographic sensitising, especially for the yellow-green and orange, than any dyes previously known.

In 1904 Homolka, one of König's colleagues, carried out the reaction used in the preparation of an isocyanine but with the addition of formaldehyde, and in the place of a red isocyanine he obtained a blue dye of which the structure was not elucidated at the time, but which proved to be a powerful sensitiser for the red, and was placed on the market under the name of Pinacyanol. It was later found that the quinoline nucleus does not form part of the dye molecule, and pinacyanol is at present made from the quinaldine salts using a compound such as iodoform or orthoformic ester, to supply the additional methine group.

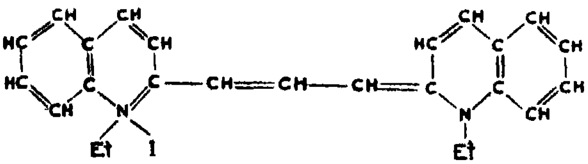
Soon after the discovery of pinacyanol, the little firm of Wratten and Wainwright in Croydon applied the new dyes, especially pinachrome and pinacyanol, to the preparation of commercial plates, and in 1906 made plates containing both pinachrome and pinacyanol, which were placed on the market under the name of 'Wratten

* Friday Evening Discourse delivered at the Royal Institution on January 31.

Panchromatic' plates. These were the first panchromatic plates to be made on a commercial scale with the new type of dyes, and following the introduction of the plates and of a series of light filters adapted for use with them, the whole art of the photography of coloured objects developed rapidly as a practical commercial process.

The cyanine dyes are derived from organic bases containing nitrogen. Bases of this kind add on two atoms or groups to form quaternary salts. Thus quinoline adds on ethyl iodide and forms quinoline ethiodide. The bases from which the first cyanine dyes were derived were quinoline and quinaldine, in which the hydrogen attached to the carbon atom of quinoline next to the nitrogen has been replaced by a methyl group.

Our present knowledge of the structure of the cyanine dyes is due very largely to the work of Dr. W. H. Mills and his students at Cambridge, and of especial importance was the paper that he published with Dr. F. M. Hamer in 1920, on the structure of pinacyanol.



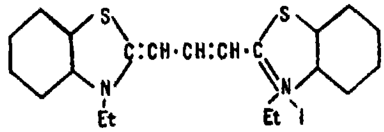
Pinacyanol ethiodide.

It will be seen that the two nitrogen atoms in the quinoline nuclei are connected by a chain of five carbon atoms with alternate double and single bonds between them. A system of this kind is known as a conjugate chain and is characteristic of the cyanine dye series.

Since the dyes in which one CH group derived from the base itself united the two nuclei are called cyanines, Mills and Pope called the dyes with three CH's in the chain carbocyanines, because it was necessary to supply one additional carbon atom. Later, Heilbron and his students at Liverpool made dyes with five CH's in the chain, and these he called dicarbocyanines. Very important dyes have been made containing seven CH's which are known as tricarbocyanines, while, as will be seen later, tetra- and pentacarbocyanines have been prepared with chains having nine and eleven CH's respectively.

It will be realised that there must be an enormous number of cyanine dyes, because we not only have the possibility of varying the number of CH's in the chain, but also we can substitute a hydrogen in the chain by another group, and we can prepare dyes from a great many different organic bases containing nitrogen.

More than fifty years ago, Hofmann made a violet dye from the quaternary salt of 1-methyl benzthiazole, and Hofmann's dye was shown by Mills to be a thiacarbocyanine, the exact analogue of pinacyanol.



Thiacarbocyanine.

A very large number of dyes has now been made from substituted benzthiazoles, and many of these are excellent sensitisers.

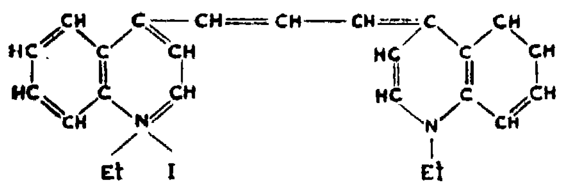
The development of these new carbocyanines has during the last few years been of the greatest value for practical photography. The new dyes from the thiazole bases are far better sensitisers than pinacyanol and the other dyes derived from quinoline, and by making use of them new panchromatic materials have been prepared which are generally known as 'super-sensitive' or 'hypersensitive' materials.

The great value of these new sensitisers is that they do not lower the general sensitivity of the emulsion, and that they show no tendency to fog, emulsions sensitised with them often being even less prone to fog than the unsensitised emulsions. As a result, the effective sensitivity of the new panchromatic materials is greater than that of the same emulsions unsensitised, and this is particularly true when the emulsion is of very fine grain and is consequently slow before sensitising, and where the exposures are made to a light source rich in the red and green rays of the spectrum. Just at the time that the new sensitisers became available, the motion picture industry adopted the use of filament lamps for the greater part of studio lighting in place of the arc lamps used previously. The filament lamps are more convenient in operation because they need much less attention and they have the advantage of being entirely silent, which was necessary when sound-recording was added to the studio problems. But, nevertheless, it is doubtful whether the filament lamps could have been used had it not been for the great increase in the sensitivity to yellow light which was available from the application of the new sensitisers. The very great change which has occurred in the methods used in the making of motion pictures is, therefore, directly traceable to the scientific work on the structure of the cyanine dyes which I have been discussing. In the same way, the use of panchromatic materials, and especially of panchromatic materials of exceptionally fine grain, stimulated the use of miniature cameras, and notably the use of those miniature cameras for photography indoors by artificial light which is often referred to as the use of the 'candid

camera', perhaps because the results are sometimes more candid than pleasing.

The introduction of the new panchromatic materials, therefore, marks a real event in the history of photography, and I think that it is probable that the years 1928–30 may be regarded as beginning a new period in photography dating from the introduction of panchromatic materials into everyday use as distinguished from their previous employment for the specific photography of coloured objects. For the scientific applications of photography, however, the increase of sensitivity obtained in the visible spectrum, while of value, was less significant. The effective sensitiveness of the new panchromatic materials, as compared with those available previously, may be three or four times, and this is of the greatest importance in motion picture work; but it is not sufficient to make any great change in the practice of astronomical or spectroscopic photography. A much more important matter was the development of sensitisers specifically adapted to use in the infra-red region of the spectrum.

The first sensitiser to give satisfactory results in the infra-red was dicyanine, which was made at Hoechst in 1906. This dye was a true sensitiser for the near infra-red, but it was very unsatisfactory in use, and although it enabled the photography of the infra-red spectrum to be carried out, it was only used by a few workers who had acquired the necessary skill, and it was not practicable to make ready-sensitised plates with it. In 1919 Adams and Haller, working at the United States Bureau of Chemistry, carried out the pinacyanol reaction, but instead of using quinaldine in which the methyl group is on the carbon next to the nitrogen, they used lepidine, which is identical with quinaldine except that the methyl group is removed from the nitrogen, being separated by another two carbon atoms. The synthesis occurs quite normally and yields a blue-green dye which Adams and Haller called kryptocyanine.



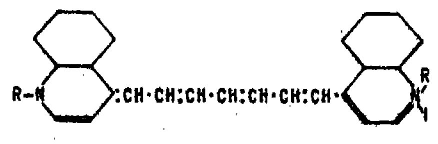
Kryptocyanine ethiodide.

It will be seen that it is a carbocyanine like pinacyanol, but that in addition to the three CH's of the chain the nitrogen atoms are separated by three carbon atoms in each nucleus, so that the conjugate chain of kryptocyanine has four more links than that of pinacyanol. As we should expect, this shifts the absorption of kryptocyanine, and also its sensitising, towards the longer wave-length, so that its maximum of sensitivity is in the near infra-red at λ 7500 A.

Kryptocyanine is a very strong sensitiser, and by its use it was at once possible to take ordinary photographs using infra-red light. So long ago as 1910, Prof. R. W. Wood took photographs by light of longer wave-length than λ 7000 A., using a strong filter to cut out all the shorter wave-lengths, and plates sensitised with pinacyanol; in these photographs the notable peculiarities of landscape pictures taken by infra-red light were manifest. The blue sky is almost black owing to the low scattering power of the upper atmosphere for the longer wave-lengths; clouds stand out in startling contrast to the black sky, and the chlorophyll of grass and trees reflects the infra-red so that foliage appears as if it was covered with snow. Moreover, because of the low scattering power of the atmosphere for the longer waves, pictures taken by infra-red light show a penetration of the distance greatly exceeding that shown by ordinary photographs or even that visible to the eye. For Wood's pictures, the average time of exposure was approximately five minutes, but with kryptocyanine, an exposure of a fraction of a second was sufficient.

When preparing kryptocyanine in our laboratory in Rochester, H. T. Clarke found that the solution contained another dye which we named neocyanine, and which we now know to be of rather complicated structure, although it is still a cyanine dye. With this dye the maximum sensitivity was at λ 8500 A., and by means of it the photography of the spectrum was extended easily as far as λ 9000 A.

About 1930, the tricarbocyanine dyes were synthesised almost simultaneously by three groups of workers, and their very powerful sensitising and ready accessibility made it possible to sensitise throughout the infra-red spectrum as far as λ 11000 A. Of the tricarbocyanines, the one having the furthest extension in the infra-red was xenocyanine, which is the tricarbocyanine from lepidine corresponding exactly to kryptocyanine, except that there are seven CH's in the chain and no less than thirteen CH's between the two nitrogen atoms, seven of them being in the chain and three in each of the nuclei. The maximum sensitising of xenocyanine is at λ 9600 A.



Xenocyanine.

Using tricarbocyanines, a great many very remarkable photographs have been taken by infra-

red light. From aeroplanes, photographs can be taken which far exceed the range of the human eye, the record for distance still being held by that taken by Capt. A. W. Stevens in 1932 of Mount Shasta in California, the machine at the time flying over the Pacific 330 miles from Mount Shasta.

In addition to these long-distance photographs, of which many examples have been made during the last few years, photographs may be taken by infra-red light which is effectively invisible to the eye. So long ago as 1931, a photograph was taken of a large group of people who could see nothing whatever at the time, the room being lighted by tungsten lamps covered by filters of so great a depth that there was no visible light at all in the room.

possible to prepare photographic plates of high sensitivity to any special region in the spectrum, and such plates are, naturally, of the greatest interest to scientific workers, and especially to astronomers and spectroscopists.

A few years ago, I classified the plates required for these purposes in order to reduce the mass of material to a system which would be available for the scientific worker. In the first place there are various types of photographic emulsions which are useful in scientific work and we must have some method of indicating these. The fastest type of emulsion was called Type 1, this having the disadvantage of a somewhat grainy structure and being of only moderate contrast. Type 2 is a somewhat slower emulsion of greater contrast and less graininess, while Type 3 is a fine grained

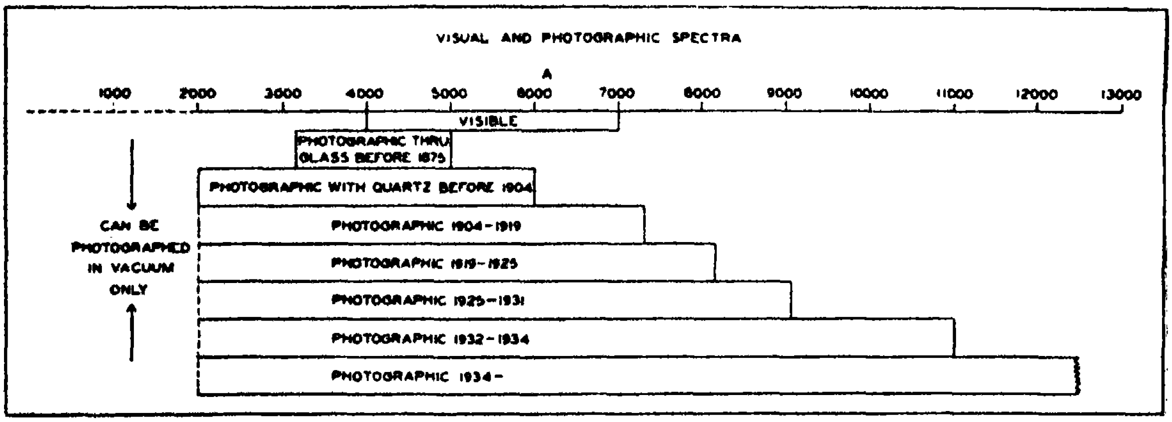



FIG. 1.

Within the last year, a still further extension of photography into the infra-red has become possible as a result of the development of tetra- and penta-carbocyanines. The method by which these long-chain dyes are prepared is due largely to Dr. W. König of Dresden. In this synthesis the chain of carbon atoms is supplied by taking a compound of what is known as a 'di-anilide' type and allowing this to react with the quaternary salt of the base. Aniline is split out and the dye is formed. By an extension of this system, tetra- and penta-carbocyanines have been prepared, of which the latter has no less than eleven carbon atoms in the chain, and these dyes have proved to be excellent sensitisers for the far infra-red. With them, Dr. Meggers of the Bureau of Standards has recorded an argon line at λ 13008 A., and Dr. Babcock at Mount Wilson has photographed the solar spectrum to λ 13000–14000 A.

There is thus a very wide range of cyanine dyes in which the absorption band and sensitising region ranges from extreme violet, or even ultra-violet in the case of such dyes as the oxacyanines, to a point in the infra-red approaching that where water vapour begins to absorb; this makes it

emulsion of high contrast. Type 4 was of extreme contrast and still less speed, and Type 5 a very slow emulsion of extremely fine grain. Now these different types of emulsion can be sensitised for different parts of the visible and infra-red spectrum, and the different sensitisings are indicated by means of letters so that it is possible for an astronomer, for example, to decide that he could afford the exposure necessary for a Type 3 emulsion and that he wanted his maximum sensitivity in the orange with as high sensitivity as possible through the green but with no particular sensitivity in the red. Such a result is shown with the sensitising known as *D*, and the particular plate that he required would be classified as 3*D*.

The progress which the development of dyes has enabled us to make in the photography of the spectrum may be summed up in an approximate form in the accompanying chart (Fig. 1).

At the top of the chart is shown the visible spectrum and that portion of it which could be photographed on a collodion plate through glass apparatus before Vogel discovered the use of sensitising dyes. Vogel's discovery extended the

photographic spectrum to λ 6000 A. The discovery of pinacyanol in 1904 extended the photographic spectrum to beyond λ 7000 A. The effect of dicyanine has been ignored in the construction of the chart, though for a few workers its use extended the photographic spectrum to beyond λ 8000 A. It was, however, only easy to reach that wave-length after the discovery of kryptocyanine in 1919, while the production of neocyanine in 1925 extended the range to λ 9000 A. Xenocyanine, made first in 1932, enabled λ 11000 A. to be reached, and the pentacarbocyanine has now extended the photographic spectrum to beyond λ 12000 A.

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# Coral Reefs of the Western Indian Ocean

THREE papers recently published* conclude the reports on the intensive study of the reefs of the Western Indian Ocean that was carried out by the Percy Sladen Trust Expedition to the Indian Ocean in 1905. Such a study necessitated investigation along several lines, geological and geographical, as well as biological, for only by a judicious combination of this kind can one hope to solve such problems as: What are the foundations on which these reefs are built? How have they been formed, and what changes are taking place in them? How can the differences in the fauna of the different areas be explained?

Oceanographers and marine biologists are greatly handicapped by the inability of geologists to agree regarding the formation of the great oceans, and this is especially the case in the Indian Ocean, across which Gondwanaland, and, at a later period, the isthmus of Lemuria, are by some supposed to have connected India and Africa and to have formed the bases on which present reefs have been built. Others believe with Wegener that the oceans were formed by the drifting apart of the continents, such isolated fragments as the Seychelles being detached and left behind during the process.

At the present day we are woefully ignorant regarding the nature of the rock of the sea-floor, and in this connexion Dr. Wiseman's study of the basal rock of Providence Island is of particular interest, as it shows that this is volcanic in origin, and is probably of Eocene–Oligocene age. The southern end of the great Seychelles Bank is volcanic, and the recent work of the John Murray Expedition has shown that the Carlsberg Ridge is, at least in part, also volcanic in structure. This raises the question whether all these areas may not have been formed simultaneously in the Eocene–Oligocene period as part of a widespread disturbance in East Africa, and perhaps contemporaneously with the curved ridges of the Malay Archipelago. Whatever the origin of these foundations, many of them are to-day covered with coral reefs or atolls, and Prof. Stanley Gardiner has concluded that these are probably of recent origin, perhaps only some 10,000 years old, while as recently as 3,500 years ago a world-wide recession of the sea-level caused the exposure of the reefs and the formation of islands. From the very outset, conditions appear to have been different in the various regions. In the Mascarene Region no atolls were ever formed and the coral reefs are now being cut back, leaving wide banks that extend for considerable distances beyond the reefs, as a result of a change that was probably world-wide, since similar conditions are to be found in the reefs of the southern part of the Pacific Ocean. In the Maldive and Chagos Archipelagoes, atolls were formed, but the islands and reefs are now being eroded away, though at different rates, so that while the Maldives are still in a comparatively stable condition, the Chagos group is composed mainly of submerged banks, the relics of former surface structures.

We are still uncertain as to the actual mode of formation of the reef and especially of the reef-rock that enables the reef to withstand the pounding of the seas, but Stanley Gardiner attributes this largely to the growth of Lithothamnioneæ—"no bank reaches the surface to form a reef unless covered by Lithothamnioneæ"—the upgrowing corals being firmly cemented together and converted into a reef by *Lithophyllum*. Thus any condition that may be detrimental to the growth of this alga would prevent the full development of the reef or, where such had been formed, its present maintenance; hence the necessity of a careful study both of the sea-water itself and of meteorological and other conditions.

Great differences are to be found in the fauna of the areas studied. The Seychelles appear to be inhabited by the remains of a fauna and flora of long standing, and this is explained by the erosion of a larger area into the smaller islands of the present time. The reef-fauna of the Maldive,

* *Proc. Linn. Soc.*, 1936. Reports of the Percy Sladen Trust Expedition to the Indian Ocean, 1905. The Reefs of the Western Indian Ocean. I. Chagos Archipelago. II. The Mascarene Region. By Prof. J. Stanley Gardiner. The Petrography and Significance of a Rock dredged from a depth of 744 fathoms, near to Providence Reef, Indian Ocean. By Dr. J. D. H. Wiseman. Concluding Remarks on the Distribution of the Land and Marine Fauna, with a List of the Water Temperature Observations. By Prof. J. Stanley Gardiner.

Chagos and Mascarene groups shows differences that can partly be explained by the differences in the reefs themselves, some reefs being stationary, while others are receding, and partly by different sources of origin dependent on their geographical situation. Throughout all the groups Stanley Gardiner found evidence of an invasion of species, probably by the dispersal of their larval stages along the great oceanic currents, from the East Indies, where there seems to have been a great outburst of new species in about Pleistocene times. One difficulty in accepting this explanation lies in the fact that we know too little about the length of time through which such a larva can survive, and, as Stanley Gardiner points out, the study of the plankton catches at different depths around the Chagos and Maldive Archipelagoes failed to reveal any larvæ that could be assigned to littoral animals. It has been suggested to me, however, that floating structures, such as tree-trunks or pieces of pumice, which after the explosion of Krakatoa drifted for years across the whole width of the Indian Ocean and were eventually flung up in thousands on all the coral banks of the Maldives, Laccadives and Chagos, may well have served as temporary rafts on which the larvæ might settle and develop to the adult stage, and thus provide a further succession of larvæ that might eventually reach even the farthest islands.

R. B. SEYMOUR SEWELL.

# Obituary

## Prof. J. G. Harrower

THE death is announced at the early age of forty-six years of Prof. Harrower, who as professor of anatomy at the King Edward VII Medical College, and consulting surgeon at the General Hospital, Singapore, rendered great services to medical education in Singapore.

Prof. Harrower received his primary education at Shields Road School, Glasgow, and then with two bursaries at Allan Glen's Higher Grade School, after which he became an apprentice in an engineering shop. On the completion of his five years' apprenticeship he joined the staff of the electrical power station of the Glasgow Corporation Tramways as a shift engineer. During this time he attended classes in the Royal Technical College, Glasgow, and so acquired that facility in mathematics which was displayed in his biometrical research in craniology. He devoted particular attention to electrical engineering so as to equip himself for practice in X-ray work and radiology, but he did not pursue this aim.

The stimulating example of Prof. Le Gros Clark, who was inspired by his life in Sarawak to begin his important researches on "The Early Forerunners of Man", prompted Harrower to take advantage of living in the same city as the Raffles Museum and to study the comparative anatomy of the tree-shrews and *Nycticebus*, as well as human remains that came to light in the Malay States.

The work of departmental teaching involved the study of Chinese coolies and, in addition to recording anomalies such as the variations around the foramen magnum, which seem to attract the attention of most anatomists who work in Africa and Asia, Harrower devoted much attention to the intensive study of the Hokien and Tamil skull and the Hylam Chinese. How carefully he dealt with this difficult subject is revealed in the memoirs published in *Biometrika* (1929) and the *Transactions of the Royal Society of Edinburgh*, 1925–26. These researches, which were accomplished in the face of considerable local difficulty in Singapore, served to bring him into touch with others similarly occupied—Prof. Joseph Shellshear in Hong-kong, Prof. O. Hill in Colombo, Prof. Davidson Black in Peking—so that a chain of links was established to form a bond of union between workers who might otherwise have been isolated.

For Harrower these contacts were particularly important, for they encouraged him to persist with his research in face of obstacles which might have been discouraging. As it was, he was a genial and happy man who was able to play his part in maintaining scientific effort in the south-eastern corner of Asia, and in so doing bring credit to his Alma Mater at Glasgow.

GRAFTON ELLIOT SMITH.

WE regret to learn that at the beginning of this year Dr. Kálmán Lambrecht, the palæontologist, died at Budapest from heart failure in his forty-seventh year. He was librarian to the Geological Survey of Hungary, and will be best remembered by his researches and writings on the fossil remains of birds. In 1921 he contributed the section on birds to the "Fossilium Catalogus", and in 1933 he published his exhaustive "Handbuch der Palæornithologie", which was reviewed in NATURE of January 19, 1935, p. 84. Dr. Lambrecht was also interested in biography, and at the time of his death he was occupied with a life of the late Baron Francis Nopcsa.

*WE regret to announce the following deaths:*

Sir Wilmot Herringham, C.B., K.C.M.G., consulting physician to St. Bartholomew's Hospital, vice-chancellor of the University of London in 1912–15, on April 23, aged eighty-one years.

Prof. Karl Pearson, F.R.S., emeritus professor and formerly Galton professor of eugenics in the University of London, on April 27, aged seventy-nine years.

# News and Views

### Mandates

MR. BALDWIN's statement on the future of the mandated territories under Great Britain in the House of Commons on April 27 no doubt went as far as it is possible to go in the conditions which, as he explained, govern the allocation of these areas and their peoples. Ultimately, consent to any proposed transfer rests with the Council of the League of Nations. While Mr. Baldwin's assurance not only that the question of a transfer of mandated territory to another Power had not been under consideration by the British Government, but also that no decision or proposal would be made without full discussion by Parliament, may in some measure allay the growing feeling of anxiety, his statement was not such as to give absolute confidence to those who fear that the wishes of the inhabitants of the mandated territories, and more especially the indigenous inhabitants, will not be consulted. The case for Tanganyika and that for South-West Africa are being argued with no little point, because of the weighty European and South African interests involved; but for those who appreciate the efforts which are being made in such territories as Togoland and the Cameroons, for example, or in New Guinea, to advance the interests and status of the native in the light, more or less as the case may be, of a scientific approach to the problems of administration, too little is heard of their even stronger claims to consideration. Any change in such territories would be little short of disastrous. The same applies in almost an equal degree to the mandated territories in Africa under France and Belgium, where, whatever may be our opinion of the suitability of the measures adopted, they have at least been framed with the advantage of the native as their primary objective.

### Eskimo Origins

IT is announced that the Danish Government has awarded the gold medal and prize of 1,000 kronen, open to international competition for the best study of Eskimo origins, to Henry B. Collins, jun., of the U.S. National Museum, Washington, D.C. The problem of Eskimo origins is one in which the Danish people by historical association are peculiarly interested. Their anthropologists have on the whole adhered to the view put forward by Steensby of an eastern source. K. Birket-Smith, for example, in his book, originally published in 1927, but recently appearing in an English translation (see p. 722 of this issue), holds that the distinctive Eskimo culture developed somewhere in the neighbourhood of Hudson Bay; and that one line of migration, which travelled to the west, acquired elements of the earlier culture of Alaska and pushed on to Siberia. In America the cumulative effect of Asiatic affinities in indigenous cultures, as well as the evidence of physical anthropology, supporting an Asiatic source for American origins, has weighed against the acceptance of the eastern theory; while the archæological evidence, which has accrued from the intensive investigations of recent years on ancient village sites in Alaska, has been interpreted in a like sense and as pointing to the extreme north-west, or even farther in Asia, as the area in which the beginnings of Eskimo culture must be sought. Mr. Collins, who himself has conducted excavations on St. Lawrence Island, Alaska, in his thesis puts forward the view that Eskimo culture is derivative from the earlier Archaic or Bering Sea and Punuk cultures, its characteristic and fundamental elements, the house with entrance passage, skin boots, sledge, etc., going back ultimately to Siberia; while the eastern Eskimo, so far from being original, represent a degeneration in culture which came about in the course of their migration from the west eastward.

### A. J. B. Parent-Duchatelet (1790–1835)

MAY 7 marks the centenary of the death of Dr. Alexandre Jean Baptiste Parent-Duchatelet, one of the most eminent hygienists of the nineteenth century. He was born on September 29, 1790, in Paris, where he qualified on August 13, 1814, with an inaugural thesis on cholera. After an unsuccessful attempt to establish a private practice, he devoted himself to public health. His numerous works included essays on the Paris sewers (1822), the influence of tobacco on the health of workmen in tobacco factories (1829), the effect of emanations from putrifying animal matter on food substances (1831), steeping of hemp in relation to public health (1832), sanitation of dissecting rooms (1835), and prostitution in the city of Paris in relation to public health, morality and administration (1836). This last publication, which appeared posthumously, is an epoch-making work and ranks as a medical classic. The second edition, which was published in 1837, contains an essay on his life and work by F. Leuret, physician to the Bicêtre infirmary. In 1829, Parent-Duchatelet was one of the founders of *Annales d'hygiène et de médecine legale*, which is still one of the most authoritative journals in the world on hygiene. He was physician to the Hôpital de la Pitié and member of the Conseil de Salubrité, of which he became vice-president three months before his death at the early age of forty-five years.

### A Close Approach to the Earth

THE closest celestial object to the earth is our own moon, the mean distance of which is roughly a quarter of a million miles. No other object is known to have approached nearly so closely to us without falling to the earth's surface. The record for a close approach had been held by an eighteenth-century

comet, discovered in 1770 by Lexell, which was distant only 1·40 million miles from the earth's surface. Some recently discovered minor planets have come fairly close to the earth; Amor, discovered in 1932, came within ten million miles, and 1932 HA within six million; but all records, cometary or planetary, have been broken by the minor planet 1936 CA discovered by Delporte at Uccle on February 12 of this year. This tiny object passed within 1·38 million miles of the earth on February 7. It has proved extremely difficult to determine the elements of this minor planet's orbit, and in particular, the period is hard to ascertain, so that it is difficult to predict the next approach. Since the object passes close to several major planets, large perturbations in its orbit may be expected. It is not impossible (though the possibility is remote) that the object may ultimately collide with the earth; there is a wide margin of safety at present. The view has been expressed that this object may belong to the same group as the great meteorites of Siberia and Arizona. On the other hand, far from colliding with a major planet, the object may eventually be thrown into a very long orbit with a very long period, or even ejected from the planetary system altogether. Should a collision occur, the damage will be very severe over an area having a diameter of a hundred miles or so, judging by the Siberian meteorite.

### Snuff-Taking

AT a meeting of the Society for the Study of Inebriety and Drug Addiction held on April 21, Dr. J. D. Rolleston read a paper on snuff-taking, which he said has increased enormously within the last five years as the result of letters to *The Times* by Sir Buckston Browne advocating the use of snuff as a protection against colds. On its first introduction into Europe in the middle of the sixteenth century by Jean Nicot, the French ambassador at Lisbon, snuff was used for the treatment of headaches and colds in the head. It soon, however, passed from being a drug to the rank of a luxury, and snuff-taking became general throughout Spain, Italy and France during the early part of the seventeenth century. Snuff-taking was introduced into Great Britain at the time of the Restoration by the courtiers and officers of Charles II in France, and its popularity increased considerably after the Great Plague. Henceforward until about the middle of the nineteenth century, the snuff box played an important part in the social life of the time, and medical and lay writers were equally extravagant in their praise or denunciation of the new habit. The most serious complication of snuff-taking, to which numerous references are to be found in the medical works of the last century, was the occurrence of plumbism due to the accidental adulteration of the snuff by lead in the packing. Numerous other adulterants which were not only detrimental to the revenue but also injurious to health were described by an Analytical Sanitary Commission in 1853. The Commission, however, was of opinion that the constitutional effects of snuff-taking were much less than in the case of smoking and chewing tobacco, the effects in most cases being mainly local. In conclusion, Dr. Rolleston said that there is no recent information as to how far snuff-taking might become an addiction, but that most probably it should be ranked with other forms of consumption of tobacco, voluntary or enforced cessation of the habit causing considerable discomfort in some cases and little or none in others.

### William Weston and Early American Engineering

AT meetings of the Newcomen Society held almost simultaneously in London and New York on April 22, a paper by Prof. R. S. Kirby of Yale University was read entitled "William Weston and his Contribution to Early American Engineering". Weston was an Englishman, possibly born in Oxford in 1753, who before he was forty years of age had gained a reputation as a civil engineer sufficiently high for him to be engaged to go to the United States as engineer to the Schuylkill and Susquehanna Navigation Co., of Pennsylvania, which proposed to connect the Susquehanna by canal with the Schuylkill, and canalise the Schuylkill from Reading to Philadelphia. He sailed from Falmouth on November 23, 1792, and arrived at Philadelphia early in January 1793. The researches of Prof. Kirby have brought to light much information about Weston's connexion with the above schemes and with the Philadelphia and Lancaster Turnpike, the Middlesex canal connecting the Merrimack with Boston, the Potomac River Locks, the Western Inland Lock Navigation, the Schuylkill River Bridge and lastly the New York City water supply. Weston returned to England probably in 1799 or 1800. The only English work of his of which there is certain knowledge is the bridge over the Trent at Gainsborough, built in 1787–91; but strangely enough, practically nothing is at present known of his early career or of the activities of his later years. He inspired confidence in those with whom he came into contact in America and, says Prof. Kirby, he had a considerable influence on American engineering.

### Exploration by Aeroplane

AN aerial survey over that part of Papua recently explored by Mr. Jack Hides, an assistant resident magistrate (see NATURE, Aug. 17, p. 251, Aug. 24, p. 290, 1935), by clearing up obscure points in the previous record, once more has illustrated the advantages of this aid to exploration in difficult country. Its assistance in giving speed and enlarging the range of vision was strikingly and conclusively demonstrated a few years ago by the aerial reconnaissance made by Dr. S. P. Morley of the Carnegie Institution, Washington, D.C., over the forest country of Central America, when in the course of a few hours flying, a large number of previously unknown ruins and archæological sites were located in forest areas of Yucatan and Honduras, which it would have been possible to reach only after weeks or even months of travel, if at all, by the ordinary means of transport. In Papua, the country covered by Mr. Hides in eight months was traversed in flights lasting

only two days, while the limestone plateau on the approach to the Leonard Murray Mountains, the "cruel tract" of needle points and razor edges, which cost him eleven days arduous and painful travel, was crossed in fifteen minutes. No less significant was the accuracy with which it was possible to observe and distinguish the tracts and types of country described in the record of the original exploration. The account of the survey given by Mr. Lewis Lett (*The Times*, April 25) fully bears out Mr. Hides' description of the country as "a wonderland". In its isolation, it should prove the happy hunting ground of the future for the indomitable anthropologist.

### Mummification in Egypt

An interesting discovery, which it is thought may prove of considerable importance for the history of mummification in Egypt, is reported from Cairo. In a tomb near one of the pyramids opened by Prof. Selim Hassan, of the University of Cairo, has been found the body of a pregnant woman completely wrapped in bandages. She was the wife of Sechem Nefer, governor of a province under Chefren, the king of the Fourth Dynasty (2650 B.C.), who built the second pyramid at Gizeh. This, it is stated by the Cairo correspondent of *The Times* in the issue of April 21, is believed to be the oldest mummy known. In another tomb, that of Knum Baef, a son of Chefren, is a large white sarcophagus, not yet opened, upon which was found a gold necklace three feet long, with beading of carnelians, amethysts and turquoises, and ivory and gold finger sheaths. A third tomb was found to contain the mummy of a man completely wrapped in bandages with the exception of the head. The earliest date at which mummification was practised in Egypt is at present somewhat obscure. It is possible that even so far back as the First Dynasty some attempt was made to ensure preservation of the body; and in the Second Dynasty the corrosion of the linen bandages in which the bodies are wrapped has been thought to be due to a practice of smearing the corpse with natron. Similar effects have been observed in burials of the Third and Fourth Dynasties. The full process, involving removal of the internal organs of the body, appears in the Fifth Dynasty. Details of the process applied to the preservation of the body of the wife of Sechem Nefer consequently will be of the greatest interest.

### Telephones for Use in Apartment Flats

The problem of installing a system of telephones in a block of flats differs in one important respect from a private telephone installation such as is used by a large business organisation privately owned. Flat dwellers, although resident in one building and indirectly employing a common staff, are independent members of the public. Hence in those countries where the provision of telephone communication is a monopoly either of the State or of companies acting under charter, the establishment of a system which enables tenants of flats to communicate with each other would be illegal. A telephone system for flats does not provide for intercommunication between tenants. The objects are to obtain immediate communication with the hall attendant and in some cases with the kitchen, garage and administrative office. In the *Osram G.E.C. Bulletin* of February, a telephone system is described in which the connexions are made to a 'reply panel' and not to a switchboard. It is designed to operate on the standard A.C. mains supply, a small power unit supplying direct current for speech and lamps so that no batteries are required. The 'buzzer' is also operated from the A.C. mains and hence the possibility of interference with radio sets in the building is removed. A picture is shown of a typical reply panel equipped for forty lines to flats. In addition, there are four service lines enabling the flat lines to be connected with all service lines, and ten 'tie lines' giving connexion when wanted to other panels. Each flat has a connecting plug associated with a calling lamp: there is also a buzzer on the panel giving an audible signal and thus relieving the attendant from the necessity of paying attention to the board except when his services are actually needed.

### Electrical Communication in Japan

In the February number of *Nippon Electrical Engineering*, published quarterly in English by the Institute of Telegraph and Telephone Engineers of Japan, the present status of Japanese broadcasting is discussed. It started ten years ago, and there are now 2,300,000 subscribers. Japan has a long and narrow configuration consisting of several islands the centres of which are covered with mountain ranges, so that conditions for broadcasting are very unfavourable. In this case it is much more effective to distribute a large number of low-power broadcasting stations over all the region than to erect a few high-power stations. The plans based upon a low-power many-station principle are being progressively realised. At the same time, in order to compete with other countries in international communications and to protect Japanese listeners against local interference, it has been decided to instal two high-power broadcasting stations, with 150 kilowatts of antenna power each, on the outskirts of Tokyo. It is computed that the field strength in Tokyo will be more than 200 millivolts per metre and will be ample to overcome any background of noise. All the equipment required for the stations can now be made locally. The Japan Broadcasting Corporation (B.C.J.) has built a special laboratory for studying radio technique. It has investigated apparatus for noise elimination and has made a direction finder for detecting the origin of noises. It is engaged in researches on television and is carrying out special experimental investigations on photo-electric tubes.

### Applications of Photo-Electric Cells

At a meeting of the Illuminating Engineering Society held on April 8, three papers were read on the uses and characteristics of photo-electric cells. R. C. Walker described the various types of light-

sensitive cells. He pointed out that the problems to which it is intended to apply them are often mainly optical, electrical or mechanical. Audible warnings are sometimes given of the opening or closing of lift gates and announcing the record of automatic weighing machines. They will also be used on automatic telephone exchanges for announcing the correct time. Great demands on photo-cells will soon be made in television transmission. They are used for transmitting pictures by wire and radio. Other uses described were in counting objects, like cigarettes, passing along a conveyor, in giving warning when the web fractures on high-speed printing machines, for burglar alarms, smoke detection in factory chimneys, regulating the speed of escalators and the timing of sporting events. L. H. McDermott described three different ways in which photo-cells have been used in connexion with problems of daylight illumination. The first was a relay to control the lighting of part of the National Portrait Gallery, the second was a device for the continuous recording of the amount of daylight illumination at Teddington and the third was used in the investigation now being carried out at the National Physical Laboratory into the lowest value of natural illumination which an office worker requires. In the third paper, W. H. B. Hall described an interesting device by which the automatic lighting and extinguishing of gas lamps at a London school was controlled by means of a photo-cell.

### Technical Exhibition at Glasgow

A TECHNICAL exhibition was held in the Royal Technical College, Glasgow, on April 24–25. This exhibition was organised by the students of the College for two purposes: to provide the public with an opportunity of inspecting the College, and to provide past and present students and their friends with the opportunity of meeting one another socially. During these days each Department of the College was open for inspection, and was demonstrating the processes illustrating the various subjects studied in the College. In addition, the students obtained the co-operation of nearly forty outside firms, which sent numerous exhibits to supplement those on view in the Departments. The exhibition was officially opened by Mr. J. W. Peck, secretary of the Scottish Education Department; Mr. G. M. Smith being in the chair. The public was given the opportunity, for the first time, of viewing the wind tunnel recently installed in the Department of Mechanical Engineering for the purpose of aeronautical research, and also the distillation plant which was presented six months ago to the Technical Chemistry Department. Other exhibits of interest included a demonstration of television, glass-blowing, metal-spraying, spectrographic analysis, ultra-violet radiation, and many others that were of interest not only to the scientifically trained person, but also to the public. A Former Students' Association has been formed, and the inaugural meeting was held immediately after the opening ceremony, Mr. J. W. Peck being the chairman.

### Fire and Vegetation

THIS very debatable subject has recently been discussed from a very statesmanlike point of view by a South African botanist, Prof. John F. V. Phillips (*J. South African Bot.*, 2, Part 1). It is pointed out that whilst such characteristic native vegetation as the beautiful 'fijnbos' (the macchia or maquis of the south-west Cape) may be irretrievably damaged by fire, and whilst there is every reason for excluding fire definitely from the water conservation areas, yet on the other hand there is also clear evidence that controlled firing, carried out at the proper season, may encourage the subsequent establishment of better pasture grasses. Further, it may be argued that absence of fires, coupled with overstocking, has contributed to a marked increase in the prevalence of the woody overgrowth, especially of species of *Acacia*, which has led to a deterioration in the pastoral value of much tree-and-grass savanna. There is thus evidence of a need for protection of certain land from any type of fire treatment, whilst in other localities an early application of controlled fire treatment is probably desirable. Such a problem requires action by a responsible body, and Prof. Phillips suggests that the Minister of Agriculture and Forestry should act as chairman of a special Commission of Conservation which should formulate a policy and co-ordinate the functions of the various Government departments involved in the carrying out of this policy. Important legal and administrative problems are concerned. The matter is regarded as urgent by Prof. Phillips, who concludes that uncontrolled firing is costing South Africa untold millions and "creating for posterity a most serious state of affairs, which no amount of money ever would be capable of putting right".

### Seed Oats for Hill Districts

ALTHOUGH oats are still an important crop in Wales, a variety suitable to the particular conditions of the hill districts has been a long-felt want. Up to the present, *Avena strigosa* or Ceirch Llwyd has been grown on this type of land, and although it is essentially a variety for wet districts and poor land, it has the great disadvantage of not yielding a good sample, being heavily awned and consequently difficult to thresh. Breeding experiments with *Avena strigosa* carried out at the Welsh Plant Breeding Station have, however, resulted in the production of a new variety, Ceirch Llwyd Cwta S. 171, which is described in Leaflet Series S. No. 3, issued by the University College of Wales, Aberystwyth (price 1s.). The chief point of interest lies in the fact that it is awnless, but in addition it yields well or better than the older variety, the grain is heavier, the bushel weight higher and the protein content greater; finally, it shows a resistance to both loose and covered smut. The amount of seed available for sowing this spring (1936) is about five tons, the wholesale price being 20s. per cwt. Co-operative societies, merchants and farmers interested in the new variety are asked to communicate with the Station at the earliest opportunity, as unless accurate estimation of the demand is obtained,

it will be impossible to gauge the acreage that should be sown down this spring in order to meet the seed requirements of the succeeding year. At the end of the leaflet some account is given of the Association of Farmers for the Growing and Marketing of Seed Oats in Wales.

### Recent Acquisitions at the Natural History Museum

IMPORTANT collections, mostly of large ungulate mammals, have been received as donations from Major P. H. G. and Mrs. Powell-Cotton and their daughters, collected by them in Tunisia, Italian Somaliland and Zululand. A collection of forty-six mammals from Uganda has been received as a gift from Captain C. R. S. Pitman, and the skin of a lion from British Somaliland has been presented by Mr. F. J. E. Manners Smith. Seventy-four photographs of mammals have been presented by exhibitors at the recent *Country Life* Exhibition of Nature Photography which was held in the Museum. Mr. F. N. Ashcroft has enriched the mineral collection by a further selection from his collection of Swiss minerals. The gift comprises 651 specimens from ninety-seven localities, and the minerals represented include datolite, rutile, sphene, apatite, smoky-quartz, rock-crystal and adularia. The Director of the Geological Survey of Uganda has presented a series of the ores and associated rocks from the Kilembe mine, Toro, Uganda. The Department has received by exchange two pieces and fragments, with the combined weight of 1,372 gm. (about 3 lb.), of the meteoric stone which was seen to fall in 1929 at Taug, 25 miles south of Kirkuk, Irak. The collection of precious stones has been strengthened by the purchase of cut specimens of rubellite, euclase, fluorite, amazonite, and rhodonite, with in some instances the corresponding rough material. A small suite of newly discovered minerals from Montana also has been purchased.

### The New Commonwealth Society

THE annual report of the New Commonwealth Society for the year ended September 30, 1935, refers to the progress of the international section of the Society leading to the establishment of national sections in the British Empire, France and Germany, while groups are being formed in Holland, Hungary and Spain. The effective membership is now 1,659, drawn from 42 countries. Plans are being prepared for an intensive appeal campaign spread over three years to place the activities of the Society on a self-supporting basis. The research activities of the Society have now been taken over by the New Commonwealth Institute, with Prof. Ernst Jäckh as director. The Advisory Research Committee has been further strengthened during the year, and as a result of the response to a research memorandum which was circulated, three series of monographs have been issued, dealing, respectively, with principles of international relations, questions of international justice, law and equity and with problems of international security. Several issues of the *New Commonwealth Quarterly* have also been published covering the whole field of research undertaken by the Institute, and the Institute participated in a study conference on "Collective Security" organised by the International Institute of Intellectual Co-operation.

### Work of the Central Midwives' Board

THE recently issued Report on the Work of the Central Midwives' Board in Great Britain for the year ended March 31, 1935 (H.M. Stationery Office, 3*d*. net) is of general interest now that so much attention is being directed to the subject of maternal mortality, in view of the midwives' work for the safety and well-being of mothers. The Midwives' Roll contained the names of 58,964 women, of whom, however, only 15,434 are practising. Of 3,922 new candidates examined, 2,936 passed. Only 18 midwives were dealt with by the Board on account of malpractice, negligence or misconduct, a tribute to the general efficiency of the service. The Report contains replies to various questions submitted to the Board for adjudication, and revisions of certain of the rules. Attention is directed to the scarcity of midwifery cases for the training of medical students, and this important matter is now the subject of consideration in conjunction with the General Medical Council.

### Tropical Medicine at Puerto Rico

THE Report of the Director, Dr. George Bachman, of the School of Tropical Medicine of the University of Puerto Rico, gives a summary of the teaching and research carried out in the School during the year ended June, 1935. Researches include important work on vitamins, tuberculosis, and parasitic diseases; a bibliography of published papers is attached. Reference is made to the regretted death of Prof. Bailey Ashford, professor of tropical medicine and mycology, best known, perhaps, for his work on sprue. The School works in collaboration with Columbia University, and full details of administration are given.

### The Pan American Medical Association

HONORARY associate membership has been conferred by the Pan American Medical Association upon the following well-known non-medical men of science: Dr. William David Coolidge, director of the research laboratories of the General Electric Co. at Schenectady, N.Y.; Mr. Myron Weiss, associate editor of *Time Newsmagazine*, New York, N.Y. Dr. Coolidge, physical chemist, was recommended for his perfection of X-ray tubes. Coolidge tubes enable X-ray specialists to make positive diagnoses of many diseases of the internal organs musculature and skeleton of the human body. Coolidge tubes are also used to destroy certain kinds of cancer. Mr. Weiss, journalist, was recommended in recognition of his outstanding services in disseminating medical and scientific information to the lay public and of his diligent promotion of goodwill among the nations whose medical men compose the Pan American Medical Association.

## Sir Robert Mond

ON Thursday, April 23, Sir Robert Mond was the guest of honour at a luncheon held to congratulate him upon the rank of Commander of the Legion of Honour awarded to him by the French Government. Prof. A. Béhal, president of the Committee of the Maison de la Chimie, Paris, at which the luncheon was held, presented Sir Robert with the insignia of the Order and spoke in the highest terms of his services to science and the human race. He was followed by M. P. Lemoine, director of the Paris Natural History Museum, M. Dussaud, who represented archæologists and M. Jean Vynaud, representing literature; and each speaker expressed appreciation of Sir Robert Mond's scientific work and influence. It is given to few Englishmen to be honoured in this way by French colleagues working in such varying fields of intellectual activity; and we add our congratulations to those expressed at the luncheon upon the distinction just conferred upon one who has long been a generous benefactor to many branches of science in different parts of the world, and has made notable contributions to several of them.

## Bust of Michael Faraday

A BRONZE bust of Michael Faraday, by Mrs. Feridah Forbes, has been presented by Sir Robert Hadfield to the Royal Society and now stands in the Society's rooms. It will be recalled that, about the time of the celebration in 1931 of the centenary of the discovery by Faraday of electromagnetic induction, Sir Robert produced a work entitled "Faraday and His Metallurgical Researches", which included an account of Faraday's life, of the conditions under which he worked and the men with whom he associated. The Royal Institution, the scene of most of Faraday's labours, has a bust and also a statue of Faraday, but the Royal Society had a portrait only. Sir Robert Hadfield therefore added to the debt which scientific workers already owe him for his memorial volume to Faraday by commissioning Mrs. Forbes to make a bronze bust, which has now been presented to the Royal Society.

## Announcements

DR. CLARENCE SMITH will deliver a lecture entitled "Modern Chemical Nomenclature" before the Chemical Society on May 14 at 8 p.m. The fifth Pedler Lecture, entitled "Synthesis in Biochemistry", will be delivered before the Society by Prof. R. Robinson on May 28 at 5.30 p.m. Both lectures will be given in the meeting hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

THE sixth Congress of German Entomologists will be held at Münden (Hanover) under the presidency of Prof. Hermann Erdnamm on May 27–30. Further information can be obtained from Dr. Walther Horn, Entomologisches Institut, Gosslerstr. 20, Berlin-Dahlem.

THE Marcel Benoit prize of 30,000 francs for the advancement of scientific research has been awarded to Prof. M. Askanazy of Geneva for his pathological investigations on cancer.

DURING the last two years, the University of Angora has been allotted two million Turkish pounds, more than a quarter of which has been spent on books and instruments. At the present time, eighty-eight professors, of whom half are foreigners, are employed at the University, together with 102 lecturers and 140 assistants.

A COURSE of "Applied Helminthology" with special reference to the control of agricultural and horticultural pests and the internal parasites of farm animals, poultry and gamebirds will be given at the London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1, on July 13–31. The lectures will be given by Prof. R. T. Leiper, Dr. T. Goodey, Dr. B. G. Peters and Dr. M. J. Triffitt. Further information can be obtained from the Secretary of the School.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in electrical engineering in Cannock Chase Mining College—The Director of Education, County Education Offices, Stafford (May 9).

An assistant master in modern physics at the Dartford Technical College—Mr. F. L. Notley, 11 Essex Road, Dartford (May 9).

An assistant inspector of fisheries (male) in the Department of Agriculture, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (May 11).

A lecturer in anatomy in the University of Cape Town—The High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (May 12).

An assistant lecturer in engineering in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (May 12).

Scientific officers for food investigation at the Low Temperature Research Station for Research in Biochemistry and Biophysics, Cambridge; the Covent Garden Laboratory; the Torry Research Station, Aberdeen; and the Ditton Laboratory, East Malling—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 14).

A professor of botany in the University of Cambridge—The Vice-Chancellor (May 15).

A temporary assistant (Grade III) in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (quote No. C.E. 5743/35) (May 15).

A mechanical and electrical engineer in the Public Works Department of the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4166).

A woman lecturer in psychology, method, etc., in St. Mary's Training College, Poona—Sister Superior, St. Helen's School, Abingdon.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 746.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## 'Spinifex' in Australia

IN the review of "The Gramineæ" by Dr. Agnes Arber in NATURE of August 31, 1935, p. 318, *Spinifex paradoxus* is referred to as one of the dominant species in the Sturt Desert of Australia. *S. paradoxus*, though widely distributed in sandy patches in the central parts of Australia, cannot be considered a dominant species. The mistake has arisen through the use of the term 'spinifex' for various species of *Triodia*, which are dominant and very conspicuous features of many parts of Central Australia both on hills and mountain ranges and on sandy areas. Thus the 'spinifex' of the explorers is almost invariably one or other species of *Triodia*, the other popular name of which is porcupine grass.

FIG. 1. Camel team on the way to Ayers Rock, Central Australia, June 1935. *Triodia* (porcupine grass, 'spinifex' of the explorers) in stalk on a red sandhill capped with Acacia bushes. Photograph by Prof. J. B. Cleland.

The origin of this confusion is puzzling. Prof. Morris, in "Austral English" (1898), under "Spinifex" refers to this mistake and gives four quotations involving the error. The first was in 1846, J. L. Stokes, "Discoveries in Australia", vol. 2, p. 209: "In the valley was a little sandy soil, nourishing the spinifex". On consulting the original, I find the locality was Barrow Island off the north-west coast of Western Australia, a situation near the sea where *Spinifex hirsutus* may possibly occur, so perhaps Morris was wrong in considering this an error. Morris's next quotations are much later, namely, 1887, 1890 and 1893. I have found three references in Captain Sturt's "Narrative of an Expedition into Central Australia", 1849, I; namely, p. 251: "The ridges were covered with spinifex, through which we found it difficult to force a way"; p. 354, "we passed over high ridges of sand, thickly covered with spinifex"; p. 407: "they [the natives] had even been amongst the spinifex gathering the seed of the mesembrianthemum" (probably *Portulaca*). Strange to say, *Spinifex paradoxus* was actually collected by Sturt on this expedition and was described in the appendix to vol. II, p. 89, by Robert Brown as *Neurachne paradoxa*. According to F. M. Bailey it was not transferred to the genus *Spinifex* until 1877 (Bentham in Hooker "Ic. pl."). Consequently there could not have been any confusion in Sturt's mind between the specimens of *S. paradoxus* he collected which were later described as *N. paradoxa*, and his 'spinifex' which rendered travelling

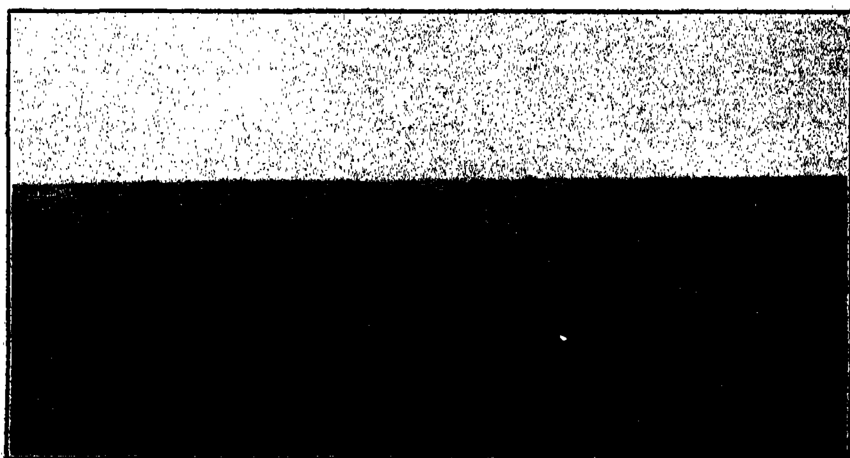

FIG. 2. Clumps of *Triodia* sp. with desert 'oaks' (*Casuarina Decaisneana*) on red sandhill near Ayers Rock. Midday halt, camels resting. Photograph by Prof. J. B. Cleland.

difficult. The name spinifex would, however, be especially suitable for plants of *Triodia* with their irritating prickly leaves like long sharp-pointed knitting needles bristling in all directions as the spines of a hedge-hog. *S. paradoxus* is not prickly and is sometimes spoken of as 'sandhills cane-grass'. Thus Sturt seems to have been the originator of the mistake and has been followed by most of the later explorers. How he came to make it is, however, still a puzzle.

I enclose two photographs (Figs. 1 and 2) taken on a recent camel trip to Ayers Rock, a very unget-at-able place. These illustrate well the abundance and appearance of *Triodia* in parts of Central Australia.

J. B. CLELAND.

University,
Adelaide, South Australia.
Jan. 10.

IN reply to Prof. Cleland's letter, which has been referred to me by the Editor of NATURE, I may say that I am quite cognisant of the use of the popular name 'spinifex' for most of the Australian species of *Triodia*, and am well aware of their dominance in the more arid regions of the interior. In referring to *Spinifex paradoxus*, however, I merely directed attention to an extremely interesting example of a xerophytic grass with rigid woody culms and male and female spikelets on different plants. The statement that *Spinifex paradoxus* is "one of the dominant species in the Sturt Desert of Australia" was not taken from the book under review, but was gleaned from the papers quoted below.

According to Prof. J. A. Prescott in his "Soils of Australia in relation to Vegetation and Climate" (Austral. Council Sci. Ind. Res. Bull, 52, p. 54; 1931), there are two extensive desert areas, consisting mostly of parallel sand-ridges bearing a desert grass association, the principal grasses being "spinifex" or "porcupine grass" (*Triodia pungens* and *T. irritans*), and "cane grass" (*Spinifex paradoxus*), *the latter common in the more eastern desert-areas* but the former more universal in their occurrence.

Prof. Cleland, himself, in a paper with J. M. Black and L. Reese on the flora of the north-east corner of South Australia (*Trans. Roy. Soc. S. Austral.*, 49, 103–120; 1925), states (p. 106) that the vegetation on the more or less shifting sandhills is meagre but very characteristic. Among the most striking plants on the higher sandhills are *Spinifex paradoxus* and *Triodia*, etc.

Prof. Cleland, of course, is a well-known authority on the vegetation of these desert-areas, having made several expeditions through them, and his statement that *Spinifex paradoxus* is not one of the really dominant grasses should be accepted as conclusive.

THE REVIEWER.

## A Unitary Model of the Galactic System

HOWEVER discordant the present views in astronomy are, they all concur in considering Milky Way clouds as real agglomerations of stars and regard the collection of stars surrounding the sun as one of these clouds ('local system'). To the common-sense evidence based on the apparently cloud-like character of the Milky Way one usually adds the following argument. The space density of stars in the direction of some galactic clouds first decreases and then increases again, thus indicating the existence of separate stellar agglomerations. The general belief in the existence of the 'local system' is based on two facts: the well-known decrease in apparent star density with increasing distance from the sun, and the distribution of brighter early stars and diffuse nebulæ along a circle inclined at several degrees to the galactic equator.

Recent discoveries have shown that our galactic system is quite comparable in size with a large extra-galactic nebula, and disposed of the comforting idea of transparent galactic space. They throw new light on this vexed problem, suggesting doubts as to the very existence of separate Milky Way clouds. Against the well-known arguments in favour of the existence of such clouds, we may now bring the following:

(1) Owing to the shearing effects of the galactic rotation, such galactic clouds would be dissipated in the course of a few revolutions, the period of which is considerably shorter than the shortest permissible cosmic time scale. Such a flattened system of clouds would be, moreover, very unstable even without shearing effects of rotation.

(2) A galaxy of such a complicated character would be quite an exceptional formation among extra-galactic nebulæ, which never resemble an accumulation of separate clouds.

(3) It should be indicated that the above-mentioned results of earlier star counts are not substantiated by recent work by Schalén, who dealt with absolutely bright stars. In all the regions investigated from Cygnus to Auriga, no increase in density has been found as far as 3·5 kiloparsecs from the sun; only in the region of Scutum—20°–30° from the direction towards the galactic centre—do Schalén's curves indicate condensations of stars.

The arguments against the existence of a 'local system' can be summarised as follows:

(1) Not the slightest dynamical effects of this system has ever been found in stellar movements, which seem to be governed by the distant galactic centre in Sagittarius.

(2) An apparent arrangement of brighter *B* stars largely depends upon a rich but isolated star group in Orion, without which the 'secondary galaxy' would be lost in a general star field. The distribution of diffuse nebulæ showing continuous spectra simply repeats the distribution of dark nebulæ.

(3) The decrease in star density with the distance from the sun can be explained by cosmic absorption of 0·3–0·4 mag. per $10^3$ parsecs in visual light; this value being substantiated by independent evidence. Two diametrically opposite regions of obscuration cross the 'local system': one in Ophiuchus (galactic long. 330°–30°), in low northern latitudes, the other in Taurus (galactic long. 100°–150°) in low southern latitudes. Both run seemingly parallel to each other and perpendicular to the corresponding galactic radius vector. The direction toward the 'centre' of the 'local system' in Carina is also perpendicular to the galactic radius vector of the sun (between both regions of obscurations); it corresponds to the minimum of cosmic absorption.

There are several other well-attested examples of heavy obscurations in the galactic belt; some authorities even admit that the major bifurcation of the Milky Way represents an apparent effect of very distant dark nebulæ. Now having in view the above-mentioned difficulties connected with the existence of individual galactic clouds, it seems natural to make one step further and to reach a new rather radical conclusion. If such an important

structural feature of the Milky Way as its bifurcation can be explained by a superposition of dark nebulæ, why should we consider this cloud-like appearance of the Milky Way as real? It is a natural consequence to suppose that less luminous spacings in the Milky Way, which are responsible for the separate appearance of, say, the cloud in Cygnus, are nothing else than the effects of obscuring matter, superposed on the otherwise continuous galactic train. From this point of view, the general cloud-like appearance of the Milky Way is just an illusion.

It seems preferable to think of our galaxy as a flattened system with the star density varying as a continuous function of the distance from the centre in Sagittarius (allowance being made for some local irregularities, like star clusters, etc.). On this distribution is superposed in our vicinity such a distribution of absorbing matter, which produces the appearance of the Milky Way clouds and of the 'local system'. Imagine ourselves located in one of the long dark patches in the Andromeda nebula, which are so similar to the obscurations of Ophiuchus and Taurus in our galaxy. In such a location we certainly would get a rather strange picture of this galaxy—its bright nucleus would disappear for us, while some minor portions of stellar distribution would appear as isolated bright star clouds. Immersed in this deceiving shadowy absorbing matter, even the best Andromedian astronomer certainly would prefer at the beginning a composite, instead of a unitary, model of his galaxy.

B. P. GERASIMOVIČ.

Poulkovo Observatory.
Feb. 27.

## Determination of Particle Weight and Shape from Diffusion and Viscosity Data

FROM a knowledge of the diffusion constant and viscosity of protein solutions, it has been found possible to estimate molecular weight and shape. By combining W. Kuhn's equation[1]

$$\eta = \eta_0\left[1 + 2{\cdot}5\,G + \frac{G}{16}\left(\frac{b}{a}\right)^2\right]$$

with Arrhenius's equation[2]

$$\eta/\eta_0 = \alpha^n,$$

we obtain:

$$\ln \alpha = \eta_0\left[2{\cdot}5\,G + \frac{G}{16}\left(\frac{b}{a}\right)^2\right];$$

where $\eta$ is observed viscosity,

$\eta_0$ is viscosity of the dispersion medium,

$\ln\alpha$ is viscosity increment at infinite dilution,

$G$ is total volume of material in 1 c.c. of solution,

$b/a$ is ratio of the long to short axis of a rod.

By substituting the value of $a/b$ obtained from the latter equation in the Herzog, Illig and Kudar equation[3] for the diffusion constant of an elongated ellipsoidal particle,

$$\frac{D}{D_0} = \frac{1}{2}\left(\frac{\sqrt[3]{\frac{a^2}{b^2}}}{\sqrt{1-\frac{a^2}{b^2}}}\ \ln\frac{1+\sqrt{1-\frac{a^2}{b^2}}}{1-\sqrt{1-\frac{a^2}{b^2}}}\right);$$

where $D$ is the observed diffusion constant,

$D_0$ is the diffusion constant the particle would have if spherical,

$a/b$ is the ratio of the short and long axis of the particle.

We are thus able to determine the ratio $D/D_0$ and from this ratio and the diffusion constant we can calculate the molecular weights of proteins.

In the accompanying table we give results for several proteins. The diffusion constants were measured at 20° C. by the refractometric method of Lamm[4] and the viscosities were measured at the same temperature with an Ostwald viscosimeter. The viscosity increments are those determined for the proteins at their isoelectric points.

The last column, giving the ratio $M_\eta/M$ (sed.), shows that these values are constant, having a value around 0·71. In calculating the values $a/b$, I did not consider the hydration of the protein particles. If the hydration accounts for the big difference between the molecular weights determined from viscosity and diffusion data, and those determined from sedimentation data, we must conclude that the hydration factor is approximately constant for the proteins investigated.

| Protein | $\alpha$ | $(a/b)_\eta$ | $(D/D_0)_\eta$ | $D \times 10^7$ cm.²/sec. | $D_0 \times 10^7$ cm.²/sec. | $r \times 10^7$ cm. | $M_\eta$ | $M$ (sed.) | $M_\eta/M$ (sed.) |
|---|---|---|---|---|---|---|---|---|---|
| Ovalbumin | 1·043 | 0·142 | 0·73 | 7·76 | 10·60 | 2·01 | 27,500 | 40,500[5] | 0·68 |
| Lactoglobulin | 1·045 | 0·134 | 0·716 | 7·25 | 10·12 | 2·10 | 31,300 | 40,000 | 0·78 |
| Serumalbumin | 1·050 | 0·123 | 0·69 | 6·10 | 8·84 | 2·41 | 47,400 | 67,100 | 0·71 |
| Amandin | 1·056 | 0·124 | 0·70 | 3·62 | 5·17 | 4·12 | 238,000 | 330,000 | 0·72 |
| Thyroglobulin | 1·064 | 0·100 | 0·65 | 2·70 | 4·15 | 5·14 | 469,000 | 676,000 | 0·69 |
| Octopus hæmocyanin | 1·065 | 0·100 | 0·65 | 1·65 | 2·54 | 8·39 | 2,020,000 | 2,780,000 | 0·73 |
| | | | | | | | | Average | 0·71 |

$(a/b)_\eta$ is value of $a/b$ calculated from viscosity data.
$M_\eta$ ,, ,, ,, $M$ ,, ,, ,, ,,
$M$(sed.) ,, ,, $M$ ,, ,, ultracentrifuge data.

The constancy of the ratio of the molecular weights calculated from diffusion and viscosity data and those from sedimentation data shows that we have a new method for the determination of the molecular weights of proteins.

A fuller report of this work will be published later on.

ALFRED POLSON.

Laboratory of Physical Chemistry,
University, Uppsala.
March 19.

[1] W. Kuhn, *Z. phys. Chem.*, A, 161, 24 (1932).
[2] S. Arrhenius, *Z. phys. Chem.*, 1, 285 (1887).
[3] Herzog, Illig and Kudar, *Z. phys. Chem.*, A, 167, 329 (1933).
[4] O. Lamm, *Z. phys. Chem.*, A, 138, 313 (1928); B, 143, 177 (1929).
[5] Unpublished determination by K. O. Pedersen.

## Thermal Conductivity of Deuterium

THE thermal conductivity of deuterium extracted from heavy water containing 99·2 per cent D has been determined.

To prepare the deuterium gas a measured small quantity of the heavy water was first converted into NaOD by adding it to the requisite amount of sodium peroxide (gentle heating dispelling the oxygen gas). The deuterium was then obtained by heating the NaOD with sodium oxalate in molecular proportions and the purification of the gas accomplished by the usual procedure of passing it directly into the evacuated conductivity apparatus through the wall of a heated 'degassed' palladium tube.

A series of determinations of the thermal conductivity at 0° C. were made over the pressure range 44–15 cm. Hg, the maximum mean temperature of the gas in the series being 1·6° C. Over this range of pressures the conductivity was constant within the limits of experimental error, the mean of seven determinations being

$$k_D = (32 \cdot 94 \pm 0 \cdot 04) \times 10^{-6} \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1},$$

as compared with the value of $k_H = 41 \cdot 3 \times 10^{-6}$ for hydrogen.

G. W. KANNULUIK.

Natural Philosophy Laboratory,
University of Melbourne.
March 17.

## Measurement of the Thermal Conductivity of Gases

DR. KANNULUIK used in the above measurement a method[1] which was devised a few years ago for measuring the thermal conductivity of a gas and was used by him and Dr. Martin to measure its value for a number of gases. In it a thick electrically heated wire co-axial with a vertical metal tube, which contains the gas, is used. A wire of very pure platinum and an accurately lapped stainless steel tube were used in the experiment on deuterium described in the previous letter.

The advantages of this method seem to have escaped attention, and I take this opportunity of directing attention to them. To do this it is necessary to recall the characteristics of other methods. Dr. Hercus and I devised an electrically heated parallel plate method, in which the horizontal layer of gas is heated at its upper surface (which prevents convection); in a recent development of this method radiation is eliminated by using two thicknesses of gas. Now, when heat crosses the interface between a gas and a solid, there is a discontinuity of temperature, but in the parallel plate method its effect is negligible. Although the plate method is very simple in principle, in practice considerable skill and time is needed to attain the steady temperatures, which are assumed in the theory of these steady state processes, and a large volume of gas is required.

An electrically heated *thin* wire has been extensively used for measuring the conductivities of gases. Steady temperatures are readily attained, and only a small quantity of gas is required The gradient of temperature near a thin wire is, however, necessarily large, and this in turn means the effect of the temperature discontinuity at the surface of the wire is large. There is difficulty, too, in eliminating convection by reducing the pressure of the gas, for molecular conduction may set in before convection is eliminated. The method has other difficulties.

Dr. Kannuluik introduced the use of a *thick* wire and gave the mathematical theory needed to enable such a wire to be used. Prof. T. M. Cherry has added to this theory, which now appears to be complete.

Using a thick wire the effect of temperature discontinuity at the wire surface is almost negligible, and can be calculated. Convection of heat can be eliminated before molecular conduction sets in. Kannuluik and Martin have shown that the method gives for the thermal conductivity of air a value which agrees with that found by careful observations with the parallel plate method[2] to the accuracy of such measurements. It agrees, too, with Weber's value for air obtained with a thin wire, but it should be added other recent determinations[3] made with thin wires are about 2 per cent higher than the values found with a thick wire and with the parallel plate methods. I believe this difference is not significant as showing a systematic difference between the methods, and that it arises from experimental errors such as those arising in eliminating temperature discontinuity and in measuring the diameter of the wire used, etc.

T. H. LABY.

London.
April 8.

[1] G. W. Kannuluik, *Proc. Roy. Soc.*, A, **131**, 320 (1931), and G. W. Kannuluik and L. H. Martin, ibid., A, **141**, 144 (1933) and A, **144**, 496 (1934).

[2] T. H. Laby, ibid., A, **144**, 494 (1934), and Hercus and Sutherland, ibid., A, **145**, 599 (1934).

[3] Awbery: article on Heat in "Reports on Progress in Physics" vol. 2, 195 (1936).

## Effect of Œstrogenic Hormones on Lactation in the Cow

THERE is evidence[1] that administration of œstrogenic hormones to lactating animals causes inhibition of milk secretion. In the case of the work cited, largely owing to the difficulty of making accurate measurements of milk secretion rate and of changes in milk composition in experiments on small animals, the evidence that inhibition occurs is not so conclusive as might be desired, nor have accompanying changes in milk composition been studied. The above difficulties are obviated by use of the lactating cow as experimental animal.

In the course of studies of the hormonal control of lactation now in progress at this Institute, the effect of the administration of massive doses of œstrogenic hormones to the lactating cow has been investigated*. Fig. 1 shows the most interesting of the results obtained when a lactating Guernsey cow was given, by intramuscular injections spread over three days, a total of 500 mgm. œstrone and 50 mgm. œstradiol benzoate. Injection into a control cow of equal amounts of the oil in which the hormones were dissolved showed this to be without effect on lactation.

It will be seen that while œstrogenic hormone caused a marked diminution in the daily milk yield (an inhibition of approximately 20 per cent) the non-fatty solids content of the milk was raised by more than 10 per cent. This finding, taken in conjunction with the fact that thyroxine administration leads to an increase in milk non-fatty solids content[2], gives reason to hope that in the near future the factors controlling the level of non-fatty solids in milk will be further elucidated, and a method of treatment

* This work has been made possible by the kindness of Messrs. Organon Laboratories and Messrs. Schering Ltd., who have given generous supplies of œstrone and œstradiol benzoate respectively.

based on physiological principles, applicable to cows secreting milk poor in non-fatty solids, may be evolved.

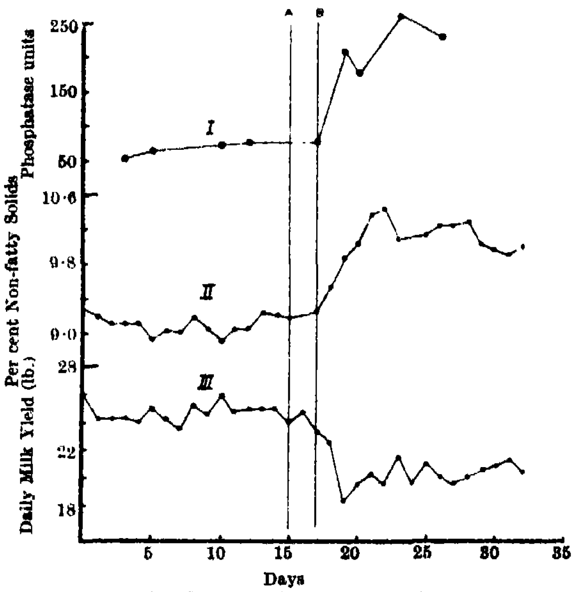


FIG. 1. I. Milk phosphatase concentration.
II. Per cent non-fatty solids in milk.
III. Daily milk yield.
A–B, injection period.

The results of this experiment confirm the suggestion from previous work[3] that the secretion of milk fat is a process not very closely related to the secretion of other milk solids, since in the dose given, œstrogenic hormone had little effect on the fat content of the milk. The percentage drop in the total daily secretion of milk fat caused by the experimental treatment was therefore far greater than the percentage fall in the daily secretion of non-fatty solids. A point of further interest, in view of the inverse relationship known to exist throughout lactation[4] between milk yield and milk phosphatase concentration, is the striking increase in the latter quantity following œstrogenic hormone administration.

These experiments, which are being extended, will be reported in detail elsewhere.

S. J. FOLLEY.
National Institute for Research in Dairying,
Shinfield, Nr. Reading, Berks.
April 3.

[1] Parkes and Bellerby, *J. Physiol.*, **62**, 301 (1926–27). Robson, *Quart. J. Exp. Physiol.*, **24**, 337 (1934–35). Smith and Smith, *Amer. J. Physiol.*, **103**, 356 (1933). Nelson, *Endocrinology*, **18**, 33 (1934).

[2] Folley and White, *Proc. Roy. Soc.*, B, 1936 (in the press).

[3] Graham, *J. Nutrition*, **7**, 407 (1934).

[4] Folley and Kay, Biochem. Soc., March 13, 1936 (*J. Soc. Chem. Ind.*, **55**, 234; 1936).

## Inhibition of the Pasteur Effect

AN explanation has been offered[1] for the action of potassium salts[2,3] in inhibiting the Pasteur effect and in increasing the respiration of brain. It was suggested that normally in oxygen only part of the cell-enzymes which attack carbohydrates are accessible to their substrates, and that respiratory energy is responsible for the maintenance of this inaccessibility; in anærobiosis the enzymes are supposed to be fully accessible. Potassium salts affect the cell-enzymes so as to make them fully accessible.

It is now suggested that the reason why this potassium effect is only observed in brain cortex[3] is because in this tissue the metabolism is mainly located in the superficial dendrites and not in the interior of the cell (as indicated by the work of Holmes[4]). In other cells the ionic concentrations at the actual site of metabolic activity cannot be altered so readily by artificial methods.

It would seem that other inhibitors of the Pasteur effect (for example, dinitro-*o*-cresol[5,6] and phenosafranine[7]) act by inhibiting a small specific fraction of respiration which is responsible for the Pasteur effect. There is thus a primary inhibition of the specific fraction of respiration which maintains the partial inaccessibility of the respiratory and glycolytic enzymes. The enzymes become fully accessible and there results a secondary rise both in glycolysis and respiration. The net effect on the magnitude of the respiration is determined by how much of the initial respiration is eliminated; this no doubt depends on the nature and concentration of the inhibitor. The sign of the net effect on the respiration is determined by whether the initial inhibition or the secondary augmentation is the greater.

It is thus possible to have either an increase, or a decrease, or even no net change in respiratory rate accompanying this inhibition of the Pasteur effect. There is, however, a qualitative change in the respiration, since the fraction which causes the Pasteur effect has been eliminated. This specific fraction of respiration is more susceptible than the rest. Thus low concentrations of cyanide can cause inhibition of the Pasteur effect without any fall[8], or even with a rise[9,10] in respiration, while higher concentrations of cyanide cause a net diminution in respiratory rate together with inhibition of the Pasteur effect.

The theory of mechanism earlier advocated[1] can thus well explain inhibition of the Pasteur effect as well as the observed respiratory changes which accompany this inhibition.

KENDAL C. DIXON.
Sir William Dunn Institute
of Biochemistry,
Cambridge.
March 19.

[1] K. C. Dixon and E. G. Holmes, NATURE, **135**, 995 (1935).

[2] C. A. Ashford and K. C. Dixon, *Biochem. J.*, **29**, 157 (1935).

[3] F. Dickens and D. G. Greville, *Biochem. J.*, **29**, 1468 (1935).

[4] E. G. Holmes, *Biochem. J.*, **26**, 2005 (1932).

[5] E. C. Dodds and D. G. Greville, *Lancet*, i, 398 (1934).

[6] D. G. Greville and K. G. Stern, *Biochem. J.*, **29**, 487 (1935).

[7] F. Dickens, NATURE, **135**, 762 (1935).

[8] H. Laser, NATURE, **136**, 184 (1935).

[9] L. Genevois, *Biochem. Z.*, **191**, 147 (1927).

[10] O. Warburg, *Biochem. Z.*, **109**, 230 (1919).

## Host Density and the Success of Entomophagous Parasites

THE subject of this communication is the effect of the density of a host population upon the relative success of a searching female parasite. So far as I am aware, this has not received any prior experimental treatment. Smirnov and Wladimirow, as reported by Gause[1], have demonstrated a relation between the increase of a parasite population and the concentration of the host, but this is a problem distinct from the present one although similar in nature.

The area which must be traversed by a female parasite searching for a host depends upon the concentration of the host. If the density of the host within a given area is reduced, then it seems obvious that the distance to be covered by the female before

encountering a host individual will be increased. A simple hypothesis would be, that the area to be traversed by the parasite is inversely proportional to the density of the host population, so that we have

$$A = 1/D.$$

If the searching is at random, however, there is no such simple relation. Although the parasite may search, say, a total of 100 units of area, actually she will search only 63 *different* units. The fundamental nature of the phenomenon is then in conformity with the conception expressed by the formula evolved by Thompson[2] for the random distribution of parasite progeny; namely,

$$Y = N\,(1 - e^{-x/N}).$$

We should, therefore, have two equations to consider in any study of the problem.

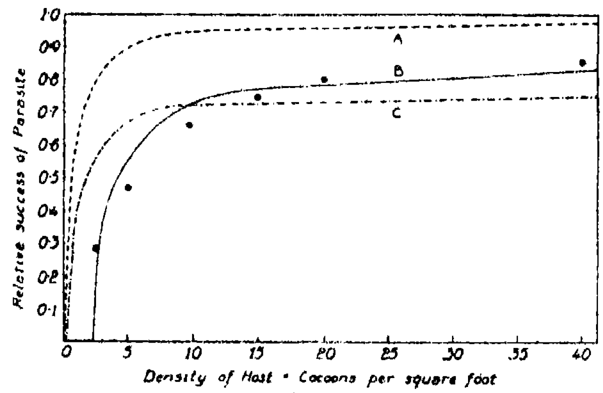


FIG. 1.

A hypothetical case, based upon the above equations, is presented in the following figures:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Density of host per 100 units of area. | 0·2 | 0·4 | 0·5 | 1·0 | 5·0 | 10·0 | 20·0 | 25·0 | 50·0 |
| Units of area to be traversed. | 500 | 250 | 200 | 100 | 20 | 10 | 5 | 4 | 2 |
| Different units actually traversed. | 99·3 | 91·8 | 86·5 | 63·0 | 18·0 | 9·5 | 4·8 | 3·9 | 1·98 |
| Parasitism. | 19·8 | 36·7 | 43·2 | 63·0 | 90·0 | 95·0 | 96·0 | 97·5 | 99·0 |

When the percentage of parasitism is plotted against the host density we obtain Curve *A* (broken line) of Fig. 1. In the experimental investigations, the Chalcid parasite, *Microplectron fuscipennis*, Zett., and its host, *Diprion polytomum*, Htg., were used. The parasite was confronted with varying densities of host population for a definite time. The results obtained are given in Curve *B*, which embodies records of a number of single females at each host density.

It will be noted that the curves representing the relation between percentage of parasitism and host density in the theoretical and experimental cases are of very similar form. If the formula for random distribution be slightly modified, by the introduction of a constant, so as to read

$$Y = N\,(1 - e^{-x/N}) - K,$$

we obtain for percentage of parasitism Curve *C*, which is still more similar to the experimental Curve *B*.

The results of the experimental work thus support the assumptions that the area searched by the parasite varies inversely as the density of the host population, and that the searching is at random, though it is clear that some modification of this simple theory is required to obtain precise correspondence.

The experiments indicate that the curve obtained is independent of climate and that it is unaffected by the presence in the host population of unsuitable individuals. The latter merely have the effect of reducing the actual host density.

The results forming the subject of this preliminary communication will be dealt with fully elsewhere.

G. C. ULLYETT.

Farnham House Laboratory,
Farnham Royal, Bucks.
March 18.

[1] *Z. angew. Ent.*, **20**, 619 (1934).
[2] *Ann. Fac. Sci. Marseilles*, **2** (ii), 69 (1924).

## Selective Fading on Ultra-Short Waves

IN a recently published paper[1] we have given data indicating that 4·5 metre radio transmission to points below the horizon is affected by meteorological conditions. A subsequent study between stations located at Atlantic Highlands, N.J., and East Moriches, Long Island, has encountered fading which further experience has shown is rarely absent, and we have made, therefore, a rather extensive study of the fading itself.

Over this 70-mile, all water, path we have transmitted at wave-lengths from 1·6 to 4·8 metres, radiating singly or simultaneously from antennæ of vertical and horizontal polarisation, under various seasonal and meteorological conditions, during the past twenty months. We find the fading to be relatively slow, compared to short wave fading; a recorder tape running at the rate of 1·5 cm. per minute separates the fluctuations satisfactorily. This fading is apparently quite erratic, but we occasionally have deep (30 db.), usually single, occasionally paired, signal drops, lasting from one to five minutes overall. We also distinguish a rapid, quite uniform, signal oscillation of the order of 5 cycles per minute, and persisting for hours, which we have termed 'scintillation'.

Simultaneous records on two different waves of the same polarisation may show considerable similarity when the wave-length difference is small or the fading slow. Exact coincidence is not observed even though the wave-lengths differ by only 2 per cent, and the shorter wave-length usually shows the worse fading (more and deeper minima per minute). Simultaneous transmission of the same wave-length on the two polarisations shows no coincidence, and the horizontally polarised component always has the deeper and more rapid fading. As the distance from the transmitter decreases, the fading decreases, practically dropping out when an 'air-line' path is reached. No definite correlation of fading with weather and no major diurnal variation has as yet been demonstrated. We find, however, that the average signal intensity falls off during the winter months. Fading on adjacent antennæ, 52 ft. and 14 ft. respectively above ground, is practically identical; the received signal level increases with height, however.

Suspecting that wave interference from multiple path transmission is the cause of some of the fading, we have recently applied the frequency sweep method of demonstrating multiple paths. A short-circuiting ring rotating in the tank circuit coil of the transmitter oscillator gave a frequency variation of 6·2 megacycles at about 66 megacycles. The receiver band width, 3 db. down, was 3·2 megacycles. Observations were made by photographing with cinema camera the pattern of the cathode ray tube, whose sweep frequency was synchronised with the rotation of the short-circuiting ring. These pictures have indicated that the fading is usually tied up with wave interference. A sample observation covering 95 seconds is given in Fig. 1, where five frames best

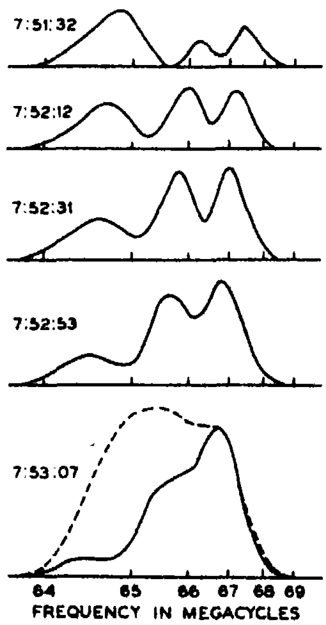


FIG. 1. Typical series of cathode ray oscillograph patterns. Ordinates are proportional to signal voltage squared. Dotted curve is the measured overall characteristic of the transmitter-receiver system for free space. Taken Dec. 13, 1935, 7.50 a.m.

illustrating the sequence have been copied from the film. The phenomenon is complex; apparently at least three components are here present. The multiple minimum structure suggests a pair of components with some 240 metres path difference ($3 \times 10^{10}/\Delta f = \Delta d$, $\Delta f$=frequency difference between minima, $\Delta d$= path difference in cm.), while the superposed broad moving minimum requires a close variable twin of one of the pair. (This fine structure can serve as a very sensitive indicator of path difference stability.)

It is our experience that while some fades are apparently due to only two components, in general the cathode tube pattern is so complicated that three or more components are required. A stratified atmosphere is the obvious explanation of these multiple transmissions, and the existence of such strata has been independently shown by plotting the dielectric constant of the air versus height from data furnished us by the U.S. Weather Bureau. This Bureau obtains daily pressure, temperature and humidity soundings of the atmosphere by aeroplane. No Kennelly-Heaviside layer reflection has yet been observed. It is hard to visualise a selective absorption condition which will yield an alternative explanation of these results. This work is being continued.


CARL R. ENGLUND.
ARTHUR B. CRAWFORD.
WILLIAM W. MUMFORD.

Bell Telephone Laboratories Exp. Station,
Holmdel, New Jersey.
Feb. 21.



[1] *Bell System Tech. J.*, 14-369 (July, 1935).


## End-points of the β-ray Spectra of Radium E and Thorium C″

THE result of applying the Konopinski-Uhlenbeck[1] modification of Fermi's[2] theory of β-ray disintegration to data previously obtained separately by us for radium E[3] and thorium C″[4] is shown in Fig. 1. In agreement with the work of Kurie, Richardson and Paxton[5] on the β-ray spectra of light elements rendered artificially radioactive by positive ion bombardment, the Konopinski-Uhlenbeck modification is shown from curves (1) and (2) to give a linear relation for $(N/f)^{1/4}$ against $E$, where $N$ is the number of cloud-chamber tracks of mean energy $E$ and $f = \eta(1 + 0\cdot355\,\eta)$, $\eta$ being equal to $H\rho/1700$.

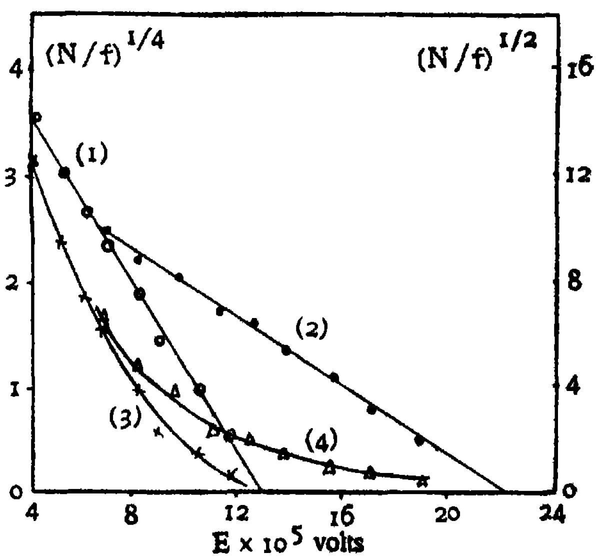


FIG. 1.

Curves (3) and (4) were obtained by plotting $(N/f)^{1/2}$ against $E$ as on the unmodified Fermi theory. The end-points, which are situated considerably beyond the last measured track, are found to occur at $E = 1\cdot35 \times 10^6$ v. and $E = 2\cdot25 \times 10^6$ v., corresponding to $H\rho = 5975$ and $H\rho = 9030$ for radium E and thorium C″ respectively.


F. C. CHAMPION.
N. S. ALEXANDER.

King's College,
London.
March 27.



[1] *Phys. Rev.*, 48, 7 (1935).
[2] *Z. Phys.*, 88, 161 (1934).
[3] F. C. Champion, *Proc. Roy. Soc.*, A, 134, 672 (1932).
[4] N. S. Alexander (unpublished).
[5] F. N. D. Kurie, J. R. Richardson and H. C. Paxton, *Phys. Rev.*, 49, 368 (1936).

## Excitation of Gamma Rays in Boron

BY using pure metallic boron, we have recently confirmed the emission of gamma rays from this element in the presence of slow neutrons. By comparing the intensity of gamma rays with that of those emitted from cadmium, and assuming that every absorption process of a slow neutron by a cadmium atom is accompanied by the emission of a gamma ray quantum, we were able to estimate the cross-section of the boron atom for the emission of gamma rays to be about one twentieth of the total absorption cross-section. On account of their low intensity, we have not yet been able to determine their quantum energy. These gamma rays may either be accompanying the well-known disintegration process found by Chadwick and Goldhaber, and Fermi and his collaborators, or they may be emitted by the capture process by $B^{10}$ to form $B^{11}$. The capture process by $B^{11}$ is excluded, for $B^{12}$ is radioactive[1], decaying with a period shorter than a second and emitting very fast beta rays, which were not observed in our case.

Though the fact that boron emits gamma rays in the presence of slow neutrons is not of special importance, it is important from the experimental side, for this element is always used as the 'shutter' for slow neutrons in investigations on the emission of gamma rays under the bombardment of neutrons.

SEISHI KIKUCHI.
HIROO AOKI.
KODI HUSIMI.

Physical Institute,
Osaka Imperial University.
March 3.

[1] H. R. Crane, L. A. Delsasso, W. A. Fowler and C. C. Lauritsen, *Phys. Rev.*, **47**, 887 (1935).

## Band Spectrum of the Sulphur Molecule

IN a recent investigation Maxwell, Hendricks and Mosley[1] have determined the internuclear distance of the sulphur molecule by means of electron diffraction patterns in heated sulphur vapour. They find this distance (for $S_2$) to be $r'' = 1 \cdot 94 \pm 0 \cdot 03$ A., which they state is definitely higher than the band spectra values. From the rotational analysis of six bands, belonging to the main system of the absorption spectrum, however, I have been able to determine this distance as 1·88 A., which must be substituted for the value 1·60 A. hitherto accepted[2], though according to Badger[3] it is incorrect. The agreement between the two determinations is now satisfactory, within the limit of error, but it may be pointed out here that the method of electronic diffraction must be expected to give a slightly greater value for $r$, because it does not refer to vibrationless molecules.

The excited state of the main system, which has proved to be of the ${}^3\Sigma_u^- \to {}^3\Sigma_g^-$ -type (even levels missing in the ground state), is subject to strong perturbations, as is well known from the vibrational analysis. According to Naudé and Christy, the levels $v' = 1$ and 3 are perturbed and $v' = 2$ unperturbed, but my investigation of the rotational structure shows clearly that the reverse is true. In the bands $v' = 2 \rightarrow v'' = n$, the sub-levels $F_2$ and $F_3$ are displaced by 10 cm.$^{-1}$ and 20 cm.$^{-1}$, respectively, from $F_1$. The perturbations are thus of the 'vibrational' type, and not of the 'resonance' form which is common in light molecules. The reason for this is easy to see. The 'resonance' form is dependent on the rapid growth of the energy difference $(B_a - B_b) \cdot K(K+1)$. Now as $B$ is small in the case of a heavy molecule (for $S_2$, $B' = 0 \cdot 22$ cm.$^{-1}$), the difference $(B_a - B_b)$ is also necessarily very small and the perturbation will extend over a much greater range of $K$ than in the light molecules hitherto studied.

A full account of the experimental details will shortly be published.

E. OLSSON.

Laboratory of Physics,
University, Stockholm.
March 17.

[1] *Phys. Rev.*, **49**, 199 (1936).
[2] Naudé and Christy, *Phys. Rev.*, **37**, 490 (1931).
[3] *Phys. Rev.*, **46**, 1025 (1934).

## Aluminium Bells

NEARLY eighty years ago, Henri Sainte Claire Deville wrote that he had cast an aluminium bell and presented it to the Royal Institution of London. He remarked in his great book, "De l'Aluminium, Ses Propriétés, Sa Fabrication, et Ses Applications", that the tone of this bell was none too good and that it was quickly damped due to the shape of the bell. He regretted that he had cast this bell in the traditional form of all bronze bells, but evidently did no further experimenting. He commented briefly on the fact that a bar or ingot of aluminium when struck sharply rang with a much better tone than his bell.

Faraday seems to have experimented with a rotating bar of aluminium which he caused to ring by appropriate tapping. He noticed two tones, rather similar, following each other in rapid succession.

These historic items come to mind now because, on February 23, when Oberlin College celebrates the semi-centennial of the discovery by Charles Martin Hall of the modern process of preparing aluminium, a great aluminium bell, three feet in diameter and three-fourths of an inch thick, will be rung in honour of this Oberlin student who succeeded so brilliantly at twenty-two years of age. Young Hall was a talented pianist, so it is highly appropriate that the ceremonies begin with aluminium music from this bell and from an aluminium violin of fair quality.

This remarkable bell has just been especially cast in a new shape by the Aluminum Company of America. It is much flatter than the classic bells of the bronze type, and really resembles a huge gong in form. The tone is splendid, sonorous, and lasts a long time. This casting was really an experiment, and the Company expects to cast another to give into the permanent possession of the Department of Chemistry, Oberlin College.

Many readers in Europe may contest the appropriateness of a celebration in honour of Charles Martin Hall, feeling that the youthful Héroult had made the discovery in 1886. The two discoveries were almost simultaneous, but the United States Patent Office records show that Hall made his discovery on February 23, 1886, while Héroult applied for and was granted a French patent on April 23, 1886. Héroult's application for a patent in the United States was denied.

HARRY N. HOLMES.

Department of Chemistry,
Oberlin College,
Oberlin, Ohio.
Feb. 8.

## Crystalline Nature of the Chief Constituent of Ordinary Coal

DUE to the pressure of other duties, I overlooked Prof. H. G. A. Hickling's presidential address to Section C (Geology) of the British Association, delivered at Norwich on September 6, 1935, and extracts from which appeared under the title "Some Geological Aspects of Recent Research on Coal" in NATURE of November 23 and November 30, 1935.

The subject of some fundamental colloidal substance, which acts as the matrix to all the materials of a coal, is, of course, an old one, but I presume to think that a modern aspect of this substance was discussed by me in NATURE several years ago[1] for the first time. I described the substance seen in coal sections in plane polarised light, and between crossed nicols, with a petrological microscope.

The same curious, all-pervading substance is more fully discussed in "The Natural History of Indian Coals"[2], where it is suggested that *fusain* contains dried up matter which in *gel* form makes *lignite* and almost entirely constitutes the substance *vitrain*. The 'rank' of a coal depends on the condition of this fundamental substance, as Prof. Hickling has found.

The value of Hill's law is also appreciated in the same memoir[3], and the question of temperature is also considered. In fact, for several years now the Geological Survey of India has used coal, or I should say the volatile percentage (excluding moisture) of a coal, as a guide to ascertaining pressure (where squeeze has occurred) or temperature (in the case of igneous intrusions) where coal bearing strata are involved. Moisture proves to be a very serious objection in these investigations for obtaining reliable criteria.

CYRIL S. FOX.

(In Camp: Garo Hills, Assam.)
Geological Survey of India,
Calcutta.
March 3.

[1] NATURE, 120, 547 (Oct. 15, 1927); 118, 913 (Dec. 25, 1926).
[2] *Mem. Geol. Surv. India*, 57, 224–225, 271, 273, 279–280 (1931).
[3] *Ibid.*, pages 95–97 and 269–271.

## Points from Foregoing Letters

Two photographs of desert flora of Central Australia showing extensive growth of the prickly porcupine grass (*Triodia*) are submitted by Prof. J. B. Cleland. This grass has been frequently referred to as 'spinifex', but this name belongs properly to the 'sandhills cane-grass' (*Spinifex paradoxus*), a less common plant in this region.

Prof. B. P. Gerasimovič brings arguments against the accepted view that our galactic system, unlike other nebulæ, consists of several groups or local 'clouds' of stars. He considers that our galaxy is a flattened system the star density of which varies continuously from the centre (in *Sagittarius*), and that the uneven appearance of the Milky Way clouds is due to the presence of dark absorbing matter, such as has also been observed in the Andromeda nebula.

The weight and shape of the 'molecules' of various proteins (ovalbumin, lactoglobulin, etc.) is calculated by A. Polson from the diffusion constant and viscosity of their solutions. The particle weight so deduced is about two-thirds of that calculated from the rate of sedimentation in an ultra-centrifuge, and it is suggested that the difference may be due to hydration.

The heat conductivity of heavy hydrogen, a constant useful in the analysis of mixtures of heavy and light hydrogen, is found by Dr. G. W. Kannuluik to be $32 \cdot 94 \times 10^{-6}$ calories per centimetre per second per degree, as against $41 \cdot 34$ in the case of ordinary hydrogen. Prof. T. H. Laby points out that the method used by Kannuluik, in which a thick electrically heated wire co-axial with a vertical metal tube is employed, eliminates the effect of temperature discontinuity at the wire surface, which affects the results obtained by the thin wire method.

The quantity and composition of the milk obtained from a lactating cow was considerably changed by the injection of large doses of sex hormones (œstrone and œstradiol benzoate). Dr. S. J. Folley submits graphs showing that while the quantity of milk was decreased the percentage of non-fatty solids in the milk became greater.

K. C. Dixon suggests that the readiness with which the removal of lactic acid formed by brain cortex tissue (*in presence of oxygen*) is inhibited by potassium salts may be due to the fact that the chemical changes involved are located in the more accessible surface branches (dendrites) of those cells. He explains, in terms of the accessibility of the glycolitic enzymes, how two of the factors of tissue respiration, namely, the change of carbohydrates into lactic acid and the further oxidation of lactic acid to carbon dioxide, can vary independently.

From the proportion of cocoons parasitised in a definite time by a Chalcid fly, C. C. Ullyett deduces that the area searched by the parasite varies inversely as the number of cocoons per square foot and that the searching is at random.

The fading of short radio waves ($1 \cdot 6$–$4 \cdot 8$ metres) travelling across a 70-mile water-path, between Long Island and the American mainland, indicates complex interference, due to the presence of two or more components, travelling along different paths. C. R. Englund, A. B. Crawford and W. W. Mumford suggest that this multiple transmission is caused by a stratified atmosphere; this is supported by measurements of the dielectric constant of air at different heights.

By means of a new formula which gives a linear relation when the energy of the electrons emitted by certain radioactive substances is plotted against a factor based upon the number of cloud-tracks in an expansion chamber, Dr. F. C. Champion and N. S. Alexander find that the highest energies of electrons given off by radium E and thorium C″ should be $1 \cdot 35$ and $2 \cdot 25 \times 10^6$ electron volts respectively.

ERRATUM. In connexion with a note in this column on April 18, Mr. F. Greenshields writes: "The impaternate males of purely arrhenotokous species are not sterile; and moreover their fertility depends on the regular abortion of the reduction division. It is this abortion of meiosis which would require an explanation if my inferences are correct."

# Research Items

## Chinese Art and Chinese Ideas of Life

MR. BASIL GRAY, of the Department of Oriental Antiquities and Ethnography of the British Museum, in a lecture before the Royal Society of Arts on January 29 (*J. Roy. Soc. Arts*, 84, March 13, 1936) surveyed the development of art in China, which is not merely a guide to, but also the actual expression of, her ideas in religion and philosophy. Although Chinese civilisation has been as varied in its development as that of Europe, it has one common element throughout, that man is never the centre of the universe. Its art aims at reflecting the rhythm of life seen in the natural world. The bronze vessels and jades of the Shang Yin and Chou dynasties, dating from early in the second millennium to 221 B.C., were connected with the worship of ancestors, but they also expressed the desire for a larger unity outside the family or clan by representing natural forces, especially the reproductive powers, in the form of animals, dragons, etc. This was the art of a feudal society, an aristocracy which had the monopoly of education and power. With the break-up in the age of the Warring States and the accession to power of the Han dynasty, Confucianism gained the ascendancy and the scholar-official became, and ever since has remained, the ruling class, to whom art was primarily addressed. The last important new influence in China before the nineteenth century was that of Buddhism, to which practically the whole country had been converted by the end of the fifth century of our era. Notwithstanding some masterpieces, sculpture never became a central art. Paradise pictures and Bodhisattvas are by far the commonest among the pictures of the T'ang dynasty recovered by Sir Aurel Stein from Tun-huang; but the Zen sect of Buddhism, which eschewed outward observance, was a home for the mystic leanings of the Chinese, showing its greatest influence in the painting of the thirteenth century.

## Stone Implements from Patagonia

A COLLECTION of stone implements from near Comodoro Rivadavia, Patagonia, numbering in all about one hundred and twenty specimens, has recently been presented to the British Museum by Mr. O. C. Elvins. A selection from the collection is figured with a description by Mr. Elvins and additional notes by Mr. H. J. Braunholtz, in *Man* of April. The stone age of Patagonia came to an end soon after the natives came into contact with the Spaniards, who recorded their use of the bow, arrow and dart. F. Ameghino puts the date at which the use of these arms was abandoned at about 1620, when the horse was introduced. These natives were the Tehuelche Indians, of whom little is known, beyond the fact that they were of more than ordinary height, the males averaging about six feet. The term 'patagon' (big foot) applied to them by the Spaniards is the origin of the present popular name of the country. Traces of the early industry of the Tehuelche are abundant in the form of flint implements and pottery. The latter, however, is found only in fragmentary condition, as the clay used, an absorbent fusible clay similar to fuller's earth, is practically devoid of plasticity and the crude pottery made from it is extremely fragile. The sites on which stone implements are found are usually along the sea coast. They are reminiscent of the sea-coast sites of Oronsay and Denmark, and like them are characterised by huge shell-mounds, particularly of clam shells, the beds being several feet thick. Burials in the sitting position, characteristic of South America from Peru southward, have been found in them, though burial places are more usually found on hill-tops. Some of the specimens were collected from the Lake Colhue Huapi, drained by the River Chico. Here flakes and worked implements are found on the surface of the sand and hard clay. This site was evidently a factory. Mr. Braunholtz points out that the collection contains a number of types which differ from those figured in the classic work of F. Outes on the Patagonian stone age.

## A Malaria Survey in Western Bengal

DR. HARRY G. TIMBRES has published the results of a malaria survey carried out by him in western Bengal (*Rec. Malaria Survey of India*, 5, No. 4, 345; 1935). The studies covered seven villages, with a population of 2,582 persons, lying in an area of 9½ square miles in the district of Birbhum. Rice is extensively cultivated, and although there are no swamps, irrigation channels are numerous, coming from small storage lakes. The survey occupied eighty-nine weeks from July 13, 1932, until March 31, 1934. Malaria is very prevalent in the district, sixty per cent at least of all cases of illness being due to this disease. It is conclusively shown that the chief mosquito conveying malaria in that region is *Anopheles philippinensis*, formerly only suspected of being a carrier. This species is definitely anthropophilic, that is, prefers man as a victim rather than animals. There are other related species in the district, anthropophilic and capable of carrying malaria, but to a much less marked degree. *A. philippinensis* is found to leave the houses during the day, and to return in numbers in the late hours of the night. It is much more readily infected with gametocytes early in the malaria season, when it is a comparatively rare mosquito, than later on when it is numerous. Other anophelines in the region, which are not concerned in carrying malaria, exhibit a preference for bovine to human habitations, and are zoophilic rather than anthropophilic. The author suggests that there may be a relation between anthropophilism and those factors which make an anopheline a carrier of malaria.

## Economic Value of American Hawks

THE farmer often bases his estimate of the economic significance of wild birds upon the exasperation of a moment, when they attack his crops or stock. An impartial survey of the food habits of such creatures almost invariably reveals extensive activity upon the credit side, for harmful insects and vermin often form a large part of the diet. The Bureau of Biological Survey of the U.S. Dept. of Agriculture has published

an investigation into "Food Habits of Common Hawks" by W. L. McAtee (U.S.D.A. Circular No. 370, November 1935). This shows that of the seventeen species of common American hawks, only four stand heavily incriminated as unfavourable to agriculture. The rest are either definitely beneficial, or their harmful and beneficial habits cancel each other, except the pigeon hawk, which may be tolerated in small numbers, though not in abundance. A sufficiently large number of stomachs has been examined to establish these conclusions, and the circular makes a plea for local investigation into the food habits of offending birds, before any measures of control are put into practice against them.

### Nuptial Coloration and Pearl Organs in a Japanese Fish

DR. MITSUO SATO in an interesting paper (*Sci. Rep. Tôhoku Imp. Univ.*, Fourth Series (Biology), Sendai, Japan, 10, No. 3, 1935) describes the nuptial coloration and pearl organs in *Tribolodon hakonensis* (Günther), a cyprinoid fish very common in Japan, occurring both in fresh and brackish water. The brackish water form attains a greater length than the fresh-water form and migrates into the river in the breeding season. The nuptial coloration and pearl organs are found in both sexes during the period of breeding, usually from spring until the beginning of summer; but they are less conspicuous in the female than in the male, especially in those from brackish water. The author finds that the change in coloration is brought about by the chromatophores, mainly the erythrophores, being caused by the change of their size and shape as well as by the increase of their numbers. The pearl organs appear a little later than the nuptial coloration, and all disappear before the coloration fades away. Their number and distribution vary with the sex, and males and females in the breeding season are readily distinguished by these organs which also vary in distribution in the fresh-water and brackish water forms. These pearl organs are shown to be conical elevations of the epidermis, and their formation is mainly due to both cornification and hypertrophy of the epidermal cells. They appear to serve as contact organs, holding the bodies of male and female together whilst fertilisation takes place in the eggs laid by the female.

### Fossil Echinoids of Belgium

IN his revision of the genus *Echinocorys* in the Senonian of Belgium (*Mem. Mus. Roy. d'Hist. Nat. Belgique*, Mém. 67, 1935) Jerome S. Smister does not essentially change the groups recognised in Lambert's monograph of 1903, but he does change considerably the views upon the relationships of species and varieties. The details of these changes cannot be indicated here, but, generally, *E. gravesi* is looked upon as the ancestral form of the Belgian fauna, and evolution in closely related varieties is expressed consistently in changes in the general form of the test. When more widely separated species are compared, many other differences are apparent, such as differences in peristome, periproct and apex. End-products of a line of evolution are easily distinguished; but the minor steps in evolution appear not to influence in an obvious way these characters, and changes in body form are resorted to as a final guide to consistent separation of varieties.

### Water-Table Effects on Fruit Trees

BULLETIN No. 154 of the Egyptian Ministry of Agriculture presents the results of an investigation by A. Fikry into the incidence of 'gumming and death' disease of stone fruit trees, particularly plum, apricot and peach, grown on terraces at different levels on the banks of the Nile. A study was also made of the influence of varying heights of the water-table on the growth of certain plum varieties and the severity of rust, shot-hole and mildew diseases. A high water-table renders the trees more subject to these diseases, the attack occurring during and immediately after the inundation period. The plum variety Wickson is very susceptible to functional disorder whilst Bokra and Japanese Gold are resistant under similar conditions, though they may be affected if grown on low land. The exceptionally high Nile flood of 1934 was detrimental to stone-fruit trees, the influence of high water-table starting either by wilting or shedding of the leaves and ending by death of the trees. Numerous photographs are presented to illustrate the condition of trees on terraces at three different levels.

### Chemical Analyses of Southern Rhodesian Rocks

BULL. 29 of the Geological Survey of Southern Rhodesia consists of "Chemical Analyses of the Rocks, Ores and Minerals of Southern Rhodesia" by E. Golding; compiled, with brief petrographic descriptions and references, by A. E. Phaup. The analyses number 329 and demonstrate the enormous amount of work which Mr. Golding has accomplished since he joined the Survey in 1926, especially as most of the rock analyses are of a highly detailed character, with determinations of more than a score (sometimes twenty-five) of constituents. The data now made available include a considerable number of analyses that have not hitherto been published; they provide a sound foundation for a geochemical study of the region and comparisons with other regions. One example may be suggested (see *Quart. J. Geol. Soc.*, 88, 423; 1932), based on the occurrence of BaO and SrO. In most parts of the world BaO is generally more abundant in igneous rocks than SrO. In Southern Rhodesia, however, there are few exceptions to the rule that SrO is the more abundant. This rare constituent is also absolutely abundant, as well as relatively. These characteristics are found in the Pre-Cambrian granites, porphyries, diorites, gabbros, dolerites, epidiorites and greenstones of several cycles, as well as in the associated and, in part, older metamorphic rocks of sedimentary origin; in various auriferous quartz-veins; and in the Karroo basaltic rocks. It would be difficult to account for the persistence through geological time of such a remarkable geochemical peculiarity except on the hypothesis that the early rocks of the earth's crust in this region were SrO-rich and that igneous activity has simply rejuvenated material already there.

### Bright Sunshine Statistics for the British Isles

SOME interesting facts relating to the climate of the British Isles are given in a paper by J. Glasspoole and D. S. Hancock that was read before the Royal Meteorological Society on February 19, entitled "The Distribution over the British Isles of the Average Duration of Bright Sunshine: Monthly and Annual Maps and Statistics", and now published (*Quart. J. Roy. Met. Soc.*, April). The number of places at which records of bright sunshine are obtained with the aid of the Campbell-Stokes sunshine recorder, in co-operation

with the Meteorological Office, has increased considerably in recent years, and the summaries covering the period 1901–30 which are given in the official publication M.O. 377, 1934, are more representative than any earlier summaries of this kind. They are the main basis of the paper under review, but some figures have been included from an earlier publication—those obtained at Ben Nevis Observatory in 1891–1902. For the British Isles generally, the period 1901–30 furnishes for the whole year some areas of less than 20 per cent of possible sunshine in the western highlands of Scotland, and of less than 25 in some industrial districts in the northern midlands of England; but this figure rises to just over 40 at a number of places on the south-east and south coasts from Felixstowe to Torquay, and to 42 in the Channel Islands. In Scotland the best is 35 in the low-lying island of Tiree, and the same figure is reached along a small strip of the south-east coast of Ireland. Consideration of individual months and seasons shows that, in general, one of the months April, May or June is the sunniest, expressed similarly as a percentage of the possible duration, April being favoured by most of north-west Scotland and Ireland, and May by the south-east of England. It is pointed out that, on the whole, the figures demonstrate the advantage of taking a summer holiday early. Comparing the duration of bright sunshine with that of the time during which rain is falling at not less than 0·004 inches per hour during the daylight hours, the two were found to be in the proportion of about 41 to 6 in the south-east of England and of 23 to 18 in northern Scotland, a striking climatic contrast.

### Disintegration of Nuclei by Fast Particles

SEVERAL papers on the disintegration of the lighter nuclei by proton and deuteron bombardment have just appeared (*Proc. Roy. Soc.*, A, March). J. D. Cockcroft and W. B. Lewis have bombarded boron with deuterons, studying the particles emitted by counting them with an ionisation chamber and linear amplifier and estimating their energy by interposing absorbing screens. Two homogeneous groups of α-particles were attributed to the reactions:

$$^{11}B + {}^{2}H \rightarrow {}^{9}Be + {}^{4}He\,;\quad {}^{10}B + {}^{2}H \rightarrow {}^{8}Be + {}^{4}He.$$

There are also proton groups, discussed in previous work and due to $^{10}B + {}^{2}H \rightarrow {}^{11}Be + {}^{1}H$, and two continuous distributions of particles attributed to $^{10}B + {}^{2}H \rightarrow 3\,{}^{4}He$ and $^{11}B + {}^{2}H \rightarrow 3\,{}^{4}He + {}^{1}n$. The disintegrations of carbon, nitrogen and oxygen by deuterons were also studied in detail, and the energy exchanges intercompared. A slight amendment of the Bethe–Oliphant mass scale for the lighter elements is proposed. In a paper by P. I. Dee and C. W. Gilbert, the reaction

$$^{11}_{5}B + {}^{1}_{1}H \rightarrow 3\,{}^{4}_{2}He$$

is studied in detail with the cloud chamber. The target was actually placed inside the chamber. The former view, that this reaction often involved the production of three symmetrically emitted α-particles, had to be abandoned, and evidence was found that the three-body process actually takes place, but usually with the emission of two particles in nearly opposite directions, the third particle receiving little energy. An explanation is suggested in which an α-particle is first emitted with a range of about 2·4 cm., and the excited $^{8}Be$ nucleus disintegrates into two α-particles in about $10^{-21}$ sec.

### Atomic Weight of Carbon

CONSIDERABLE interest has recently been taken in the value of the atomic weight of carbon, the International value 12·00 being probably somewhat too low. Most recent determinations of the densities and compressibilities of gaseous hydrocarbons and oxides of carbon have yielded higher values, and the mass-spectrograph value of $^{12}C$ is also somewhat higher than the whole number on the chemical scale. An allowance for approximately 1 per cent of $^{13}C$ raises the average value for the mixture of isotopes in ordinary carbon to about 12·01. G. P. Baxter and A. H. Hale (*J. Amer. Chem. Soc.*, 58, 510; 1936) have now carried out combustions in oxygen of some aromatic hydrocarbons of high molecular weight. The direct combustion of carbon in oxygen is not a suitable method for high accuracy, since the practical difficulties of preparing really pure carbon are very great, if it is possible to do so at all, while natural carbon is always impure and the composition of the impurities uncertain. The combustion of organic compounds was used by Dumas and Stas and also, in 1909, by Scott, but in these the formula of the compound was used in the calculation. Baxter and Hale have burnt pyrene, chrysene, triphenylbenzene and anthracene in oxygen and weighed the carbon dioxide and water. From the weight of water the weight of hydrogen was calculated. These higher hydrocarbons contain only a few per cent of hydrogen and no assumption of formula is necessary. Various uncertainties are involved in the calculation of the results; for example, the atomic weight of hydrogen and the isotopic composition of the oxygen and hydrogen in the materials. These uncertainties are small in magnitude. The final result, which is only provisional, is about 12·009, which agrees with some mass-spectrograph results.

### Ketene Diacetal

MUCH attention was given a few years ago to the supposed compound ketene diacetal, $CH_2{=}C(OC_2H_5)_2$, which was later shown not to exist. F. Beyerstedt and S. M. McElvain (*J. Amer. Chem. Soc.*, 58, 529; 1936) now report a preparation of this substance by elimination of halogen acid from a halogenated acetal, $XCH_2CH(OC_2H_5)_2$, by means of alcoholic potash. Experiments showed that the elimination of halogen hydracid could be stopped at the ketene acetal stage by carrying out the reaction with iodacetal ($X = I$) and potassium in tertiary butyl alcohol. Sodium was much less satisfactory. The reaction was completed in one or two hours at the boiling point of the tertiary butyl alcohol, and after removal of the precipitated potassium iodide the ketene acetal was separated from the tertiary butyl alcohol by fractionation. The yield of purified product was 52 per cent of theory. The ketene diacetal is a colourless liquid boiling at 124°–126°, which reacts rapidly at room temperature with both water and ethyl alcohol with the evolution of considerable heat, to form ethyl acetate and ethyl orthoacetate, respectively. It polymerises on distillation or heating, and even slowly on standing at room temperature, to a semi-solid white gum. It is clear from these properties that the substance previously described as ketene diacetal was not this compound, which has not previously been obtained The boiling point is higher than was expected.

# Exploring for Plants in Southern Tibet

By Capt. F. Kingdon-Ward

HAVING left Tezpur, an ancient Assamese town, on the right bank of the Brahmaputra, towards the end of April last year, and crossed the outer range of the Assam Himalaya by the Pankim La at 10,000 ft., I arrived in the dry river valleys early in May. There is only one possible route over the great range in a distance of three hundred miles, between the Bhutan frontier and the gorge of the Brahmaputra; east of the Bhareli River savage tribes—Daflas, Akas, Abors and others—bar the way. Travelling leisurely northwards, the Tibetan frontier was crossed by the Se La (14,000 ft.) early in June and Mönyul was reached. The rainy season had begun, and this part of the journey, over a series of moderately high passes, was cold and wet.

Already the alpine flowers were in full bloom. Two dozen species of *Rhododendron* were collected, several of them new to science, and half of them new to Assam. Several Chinese species appeared, still further confirming the unity of the eastern Himalayan and Chinese alpine floras. Certain species of *Primula* occurred in vast numbers, painting the meadows bright colours; among them the mauve *P. atrodentata*, *P. Roylei* and *P. Gamblii*. The last two have each two distinct colour forms, yellow and blue-violet.

In the middle of June, I crossed the snow range by two passes both at a height of more than 17,000 ft. and reached the dry Tibetan plateau at the headwaters of the Subansiri. Here the flora was entirely different. There is no forest, but a few trees grow in the villages, where the crops are irrigated. Along the irrigation channels a charming bi-coloured 'sibirica' iris grew in masses. The dry rocky slopes are dotted with thorny bushes and scattered herbaceous plants. To the west, the country grows more and more arid, but eastwards the forest reappears even on the north slopes of the Himalayan range itself. So I turned north-eastwards, and crossing two more ranges at 16,000 ft. altitude, reached the sacred valley of Tsari. Incredible numbers of primulas—chiefly a yellow-flowered form of *P. alpicola*—filled the meadows. Many endemic species grow in this country, where the Tibetan rivers leave the plateau to pierce the Himalaya; for example, *Meconopsis argemonantha* (the only known white-flowered species), *Primula Cawdoriana*, *Rhododendron hirtipes* and *R. temoense*, *Cyananthus Wardii*, *Lilium Wardii* and others.

From Tsari, the next range to the north was crossed, and I travelled for eight consecutive days through quite unknown country. The high ranges were all well forested now with conifer forest above and mixed forest below. As the Tsangpo was approached, *Pinus tabulæformis* became the dominant tree (10,000–11,000 ft.). The Tsangpo was reached at Lilung, thus linking up the new route with my route of 1924. I turned eastwards down the Tsangpo valley and on July 22 reached Tsela Dzong. I was now well into the river gorge country, at the wettest season of the year. Continuing northwards, Tongkyuk was reached, and on August 1 I set out to explore the great unknown range of snow peaks which I had reason to believe stretched east and west some thirty or forty miles north of the Tsangpo.

For the first time for two months I found myself below 10,000 ft. The Yigrong River was explored to its source; it was followed westwards through a series of magnificent wooded gorges for eighteen days. At first the forest consisted largely of broad-leafed trees, including oaks, laurels, maples and birch, but gradually conifers increased, chiefly *Pinus excelsa*, *P. tabulæformis* and *Tsuga Brunoniana*. There were snow peaks and glaciers on both sides of the river, but the bulk of the great snow range lay to the south, where there were peaks probably 25,000 ft. high. The source of the Yigrong is in the largest glaciers known north of the Tsangpo.

Recrossing the range by a high pass, I reached the Gyalam (that is, the Lhasa-China road) at Gyamda, about 120 miles east of Lhasa. The country here is much drier again; there is far less forest, and fewer species of trees. It was now the end of August, the height of summer there, and numbers of beautiful flowers were in bloom, including the robust and handsome *Salvia Wardii*, the half shrubby *Dracocephalum Hemslyanum*, with large sapphire blue flowers, *Codonopsis convolvulacea* and species of *Adenophora*.

Continuing westwards, the Lhasa road was followed for two days, and then I turned southwards to cross the unknown country which separated me from the Tsangpo. Crossing the range at 17,000 ft., I reached the Tsangpo sixty miles west of Lilung. The blue-flowered *Onosma Waddellii* was in fruit here, also the delightful sand dune plant *Oxytropis sericopetala*. A different route back to the headwaters of the Subansiri was followed, and plants and seeds were collected.

Finally, in October, I once more crossed the great Himalayan range, and varying my route, covered a good deal of botanically unknown country. One of my last finds was a charming new species of slipper orchid (*Cypripedium*). I arrived at the Assam plain again on the last day of October, after a journey of six months.

During that time I had travelled about 1,500 miles, crossed more than twenty passes between 15,000 ft. and 17,000 ft., and explored 600 miles of unknown routes. Many hundreds of species of plants had been collected, including a number of new species, and seed of some of the best for English gardens was obtained. The great snow range north of the Tsangpo was definitely located and followed for a hundred miles.

Botanically, it was possible to recognise three main divisions of the Tibetan flora, which correspond fairly closely with the three stages in the degradation of the plateau. But the observations and collections also emphasise the unity of the Tibetan flora as a whole, and its close similarity to that of western China and the Himalaya. The Tibetan flora is not of central Asian affinity; Tibet, western China and the entire Himalaya form a phytogeographic whole, which may be distinguished by the term 'Sino-himalayan'.

# Disperse Systems in Gases: Dust, Smoke and Fog

THE Faraday Society held one of its biannual general discussions in the Chemistry Department of the University of Leeds on April 20–22. The subject of the discussion in this instance was "Disperse Systems in Gases : Dust, Smoke and Fog". The meeting was held under the joint chairmanship of Sir Robert Robertson and Prof. F. G. Donnan, owing to the illness of the Society's president, Mr. William Rintoul.

Among the distinguished foreign and overseas guests of the Society attending the discussion were : Prof. J. Firket (Liège), Dr. E. Hiedemann (Cologne), Prof. H. Köhler (Uppsala), Dr. and Mrs. R. Meldau (Berlin-Charlottenburg), Dr. J. L. van der Minne (Amsterdam), Prof. H. Remy (Hamburg), Dr. P. Schuftan (Munich), Dr. H. Schmeel (Darmstadt), Dr. P. Siedler (Frankfort-on-Main).

The discussion was divided into two parts, the first dealing with the general properties and behaviour of dispersed systems, whilst the second was the industrial aspect of such systems in air and gases. In addition, the discussions on Part I were subdivided into those dealing with systems of non-volatile particles, such as smokes and dusts, and systems of aqueous and other volatile particles, such as mists, clouds and fogs.

In an introductory paper to the first part of the discussion, Prof. R. Whytlaw-Gray of the University of Leeds gave a comprehensive summary of modern knowledge of smokes. He pointed out that one of the most fundamental properties of any dispersed system in a gas was its power of spontaneous coagulation. He showed that when dealing with ideal smokes in the laboratory, the decrease of number of particles with time was in conformity with the theoretical equations of von Smoluchowski. Dr. W. R. Harper (Bristol) criticised the derivation of these equations and submitted an alternative method of treatment, which, however, led to the same final formulæ. One point of great interest arose out of the discussion on coagulation which followed, this being the extreme lack of information regarding the initial formation of particles from volatilised substances, and whether there is in fact a primary particle (that is, a homogeneous particle of minimum size as distinct from larger particles consisting of loose aggregates) or not. The microscopic examination of smokes of crystalline substances and the work of Prof. Fuchs (Moscow) on sulphuric acid droplets tends to support the former view. The effect of the reduction of pressure in increasing the rate of coagulation was also discussed.

Two other phenomena exhibited by dispersed systems were also brought before the meeting. The first was the enforced and very rapid coagulation of particulate matter by means of sound waves of supersonic frequencies. In this connexion, Dr. Hiedemann gave a description of his inspiring and extremely comprehensive experimental researches, whilst Prof. E. N. da C. Andrade put forward a theoretical explanation of the phenomena. In the somewhat lively discussion which followed, the economic possibilities of using this method in industry were treated. The other phenomenon was that seen so frequently above radiators, that is, the deposition of particulate matter on cold surfaces, and the reverse effect of a dust-free space around hot bodies. Mr. H. H. Watson (Porton) gave an account of an experimental investigation of this effect, which was followed with an attempted theoretical explanation by Dr. W. Cawood, based on the assymmetrical bombardment of the particles in a temperature gradient by the gas molecules.

Mr. H. L. Green (Porton) gave an account of an investigation of certain harmful commercial dusts. After describing a method of measuring the particle size distribution, he showed that in all such dusts the range of size was about $0 \cdot 2\mu - 2\mu$ in diameter, and that the number distribution appeared to be quite random. He pointed out the importance of such measurements in industry due to the probability that certain sizes of particles are more toxic than others.

The next part of the meeting, that is, the part dealing with volatile particles, somewhat naturally resolved itself mainly into a discussion on atmospheric conditions. Dr. G. M. B. Dobson (Oxford) presented the introductory paper, and whilst giving a résumé of our present knowledge of these systems, at the same time stressed the points about which very little is known, such as the distribution of fogs and particulate matter around towns and the effect of dispersoids in cutting off sunlight and daylight.

That in country air the nuclei upon which fogs and mists condense consist mainly of very fine particles of sea salts has been shown by J. H. Coste and H. L. Wright. At this meeting, however, Mr. Coste showed that, in towns, in addition to such nuclei there are nuclei of sulphuric acid droplets, and described how the sulphuric acid content of the air might be determined. He also put forward experimental evidence in support of the view that droplets of nitrous acid are formed by the various combustion processes in a city, which also act as hygroscopic nuclei for the formation of fogs. Prof. Hilding Köhler gave an account of his researches, mainly carried out on the slopes of the Haldde, which also show that the centres of condensation in country air mainly consist of sodium chloride. In addition, he gave a very complete account of the thermodynamics of condensation upon such nuclei. Similar considerations were also shown by Dr. C. F. Goodeve (London) to apply to the old problem of the behaviour of sulphuric acid mist in air of different water vapour concentrations. The determination of the actual mass and size of these atmospheric nuclei was described by Prof. J. J. Nolan (Dublin), who showed that they were identical with the Langevin irons, and the average radius was about $2 \cdot 3 \times 10^{-6}$ cm. Prof. J. C. Philip then gave a description of the part played by certain hygroscopic nuclei of ammonium chloride in the formation of fog.

As a rather disturbing climax to this part of the discussion, during which so many of the properties of the nuclei necessary to form a fog had been investigated and described, Prof. J. Firket gave an account of those terrible days during December 1930 when sixty-three people died and several hundred were affected as a result of a dense fog along the Meuse Valley. Prof. Firket described how he and his collaborators proved that the toxic material in

the fog was almost certainly sulphur dioxide and its oxidation product sulphuric acid (the latter being the more poisonous and the actual cause of the casualties), formed in the combustion of coal. It is of interest to note that one fifth of the sulphurous products had their origin in the domestic fireplace. Prof. Firket also said that, given the same exceptional atmospheric conditions, undoubtedly the accidents would occur again unless special plants were installed to absorb the sulphurous fumes from the flue gases of industrial furnaces.

The section of the discussion dealing with the industrial aspects of dispersed systems was opened by Dr. R. Lessing (London), who gave a comprehensive account of the dusts, smokes and fogs formed in various industrial processes, and then described how the flue gas problem had been successfully overcome in Britain. He showed that in the burning of coal, by means of efficiently designed furnaces, the black smoke of unburned carbonaceous matter, once so common, had practically disappeared, so that only a dust of siliceous ash was left in the flue gases. However efficient the furnace, the sulphur oxides are unchanged, and consequently in modern practice the flue gases must be washed by an alkaline solution in order to eradicate them. Mr. G. Nonhebel (Durham) described how the Howden–I.C.I. flue gas scrubber carried out this process. The essential point of the system appears to be the strict control of the $p$H of the alkaline scrubbing water in order to obviate the copious encrustation of calcium sulphate in the scrubbers.

Apart from the problem of cleansing flue gases in order to prevent air pollution, there is also the problem of precipitating dusts and smokes in such a way that they can be collected. The most widely used method is the Lodge–Cottrell process of electrical precipitation. In this connexion, Dr. R. W. Lunt (London) discussed the electrical efficiency of the ionisation in such processes. He showed that the ordinary laws do not hold in the corona discharge and that by applying more refined theoretical methods it can be proved that the efficiency is far below the maximum.

A paper was presented by Dr. J. S. Owens (London) entitled "Twenty-five Years of Progress in Smoke Abatement". The study of the various observations taken by Dr. Owens in different parts of Britain shows that the choice of the word 'progress' is unfortunate, as the pollution in certain areas is worse than it was twenty-five years ago. Dr. R. Meldau then described the extreme difficulties of forecasting where dust should distribute itself in and around cities owing to the microvariations of the atmospheric conditions. Mr. Bosanquet dealt with the theoretical aspects of the same problem, in particular, the spread of pollution from chimneys, taking into account the various phenomena of eddy diffusion. He showed that at points close to the chimney the concentration at ground-level is small and that it reaches a maximum at a distance of the order of ten times the chimney height.

Prof. D. Brunt then described in a general way the dissipation of fogs in open spaces such as aerodromes. He took the view that this is now mainly a problem for the engineers. Indeed, one of the results of the discussion was to show that the abatement of atmospheric pollution is now a technical and economic rather than a scientific problem.

In conclusion, the Faraday Society is to be congratulated upon organising an extremely interesting and useful discussion, which should have important consequences in this field of scientific study—a field moreover which has a direct bearing upon the improvement of the living and working conditions of people in industrial cities.

# International Conference on Timber Utilisation

CHANGES in industry and in housing which have taken place on the Continent since the Great War have altered the incidence of demand for wood, more especially in the small material which formerly was used for firewood or turned into charcoal. Faced with a big unsaleable surplus of such material, forest owners have tried to find new outlets for it, and progress in this direction may be summarised as the use of scientific control in methods of turning wood into a homogeneous product suited to mechanised mass-production conditions of manufacture.

Of the papers read at the Second International Conference on Timber Utilisation recently held in London, the bulk referred more to the disposal of the wood in the round from the forest than to the actual processes of manufacture, and those which referred to uses of wood other than that of a construction material dealt only with very general aspects of the case which have been known for many years.

Dr. von Monroy classified these other uses into wood as a source of energy (other than that of direct combustion, of course), as a textile, a food-stuff and a raw material in chemistry. He himself demonstrated part of the source of energy use by coming to the Conference in a motor-car driven by producer gas, and spoke of the recent hydrogenation processes evolved for converting wood gas into light and heavy fuel oils.

Dr. Friedrich Bergius in his paper on "Wood, a New Raw Material" dealt with the subject of the preparation of 'wood sugar' and its derivatives, alcohol, glycerol, etc., where improved technique has, he claims, attained the conversion of the whole of the wood substance except the lignin, or roughly two thirds of the original wood. This, he said, results in the possibilities of obtaining from one acre of woodland as much food-stuff as from one acre of arable land and with less labour in cultivation.

Prof. E. Hagglund, following Dr. Bergius, referred to the textile aspect, as concerned with artificial silk and wood pulp. Here, again, progress has lain in improvements in manufacturing methods leading to a reduction in the price of producing viscose and to the use of sulphate pulp in the cuprammonium process, which until then had been restricted to cotton linters. He foreshadowed the use of broad-leaved species in the manufacture of high grade pulp, from which they have hitherto been excluded on account of the shortness of their fibre.

All these aspects of wood utilisation deserve close study by forest owners and wood-consuming industries in Great Britain, in view of the relatively high proportion of low-grade material which newly-formed British forests will produce in the next few decades until they approach maturity; but it would be a grave mistake to think that the problem is already solved. Scientifically it may be; economically it definitely is not. As a stand-by in times of emergency, such derivatives of wood can be of the greatest value, but in emergency economy counts for little. In other times the question of cost of production is all-deciding, and in Great Britain other raw materials are cheaper to produce.

The three papers summarised above were given by men working under conditions of limited trade competition or of large supplies of cheaply transported timber, neither of which conditions obtains ordinarily in Great Britain. Therefore, before any large industries can be built up in this country by the application of chemical methods, the problem of *insuring continued supplies cheaply to the factory* must first be solved.

This is not to say that the study of wood chemistry in Great Britain is not worth doing; but study must be directed to objects which will fit in with the economic conditions of the country, and it will not necessarily follow lines developed in totally different surroundings.

## Educational Topics and Events

CAMBRIDGE.—The Iron and Steel Industrial Research Council has decided to make a grant of £500 a year to the University for the purpose of supporting scientific research on corrosion, and has indicated its intention of continuing this grant for a short period of years subject to the satisfactory progress of the work. The grant will enable Dr. U. R. Evans to continue the investigations which he is at present carrying out while holding the Royal Society Armourers and Brasiers Company research fellowship, his tenure of which terminates shortly. Dr. Evans will retain complete freedom in planning and carrying out this work, and, while reporting the results to the Corrosion Committee of the Iron and Steel Industrial Research Council, will publish them in scientific journals or in the reports of the Corrosion Committee as may appear to him most appropriate.

The seventh course of Scott lectures will be given by Prof. E. V. Appleton, of St. John's College, Jacksonian professor elect, in the Cavendish Laboratory at 4.30 p.m. on May 11, 13, 15 and 18. The subject of the course will be "The State of the Upper Atmosphere".

ST. ANDREWS.—Mr. D. C. Innes has been appointed to the new chair of geology established by a recent Ordinance of the Court, approved by His Majesty in Council, the appointment to take effect as from August 1. Mr. Innes was appointed lecturer in geology in the University in 1920 and raised to the status of reader in 1927.

Prof. D'Arcy Thompson has been invited to deliver the Lowell Lectures in Harvard University, and the Senatus Academicus of the University has therefore agreed to grant him the necessary leave of absence to enable him to accept this invitation.

Major A. H. R. Goldie, superintendent of the Meteorological Office (Air Ministry), Edinburgh, has been awarded the degree of D.Sc. for a thesis entitled "The Mechanism of the Depressions of Temperate Latitudes".

On April 23 the Irish Free State Dail passed a motion by 58 to 40 votes putting into force the Bill to abolish university representation. At the next general election, therefore, the three seats for Dublin and the three seats for the National University of Ireland will cease to exist (*The Times*).

## Science News a Century Ago

### Prof. D. Don at King's College, London

ON May 2, 1836, Prof. David Don (1800-41), who had succeeded Burnett in the chair of botany in King's College, London, gave his inaugural address. "The Professor," said *The Times* of May 3, "commenced by requesting the indulgence of his auditory, as he was unused to addressing public audiences, and as the lecture he was about to deliver was the first he had ever attempted. He then proceeded to give a detailed account of the history of botanical science and stated its progress from the times of Aristotle and Hippocrates to the days of Linnæus and Jussieu". After directing attention to the various publications relating to botany, he "impressed upon his audience the great importance of the study of botany, its immediate connexion with medical knowledge, and the necessity of its consideration by medical students, its importance to a proper knowledge of agriculture, and its great utility to the illustration of various other branches of learning. . . . Mr. Don was at all times rather inaudible and apparently labouring under the influence of those feelings which generally render persons unused to address a public meeting rather nervous. The general excellence of the lecture was, however, quite sufficient to redeem any drawback which this might have occasioned".

Don was the son of George Don (1770–1814) and brother of George Don (1798–1856), both well-known botanists. Educated in Edinburgh, he went to London in 1819, and in 1822 succeeded Robert Brown as librarian of the Linnean Society.

### Annular Eclipse of the Sun, May 15, 1836

JUST as the reappearance of Halley's comet in 1835 had attracted much attention in Great Britain, so the annular eclipse of the sun on May 15, 1836, also created very widespread interest. Ten days before the eclipse, *The Times* on May 5 informed its readers that "On Sunday, May 15, in the afternoon, there will be a large and visible annular eclipse of the sun, which will be central in the north of England, Ireland and in the south of Scotland. It will begin at 50 minutes 59 seconds past 1 o'clock, and will end at 39 minutes 8 seconds past 4. Over England and the adjacent parts the light and the heat of the annular obscuration will be a little more than one tenth of the full sun; and should the atmosphere prove to be clear at the time of the greatest magnitude it may be expected that several of the largest stars will be visible. The breadth of the annulus for England will be about 142 miles. The whole body of the moon will appear on the disc of the sun, leaving a small ring or circle of light on the external edge of the sun, whence its name annular, from *annulus*, a ring".

**Dichroism of Crystals**

On May 5 and 12, 1836, Henry Fox Talbot (1800–77), the pioneer of photography, read a paper to the Royal Society entitled "On the Optical Phenomena of Certain Crystals", in which he gave an account of the optical properties of certain minute crystals, obtained by the evaporation of a solution of borax in phosphoric acid, when they were examined by the polarising microscope.

In a postscript to the paper, the author gave an account of a new species of 'dichroism' in crystals, to the discovery of which he was led by applying to them his peculiar method of observation with polarised light. In these experiments the crystals themselves performed the office of the analysing plates, acting on light previously polarised and transmitted through a plate of mica. The experiments tended to confirm the views of Sir David Brewster and others as to the general cause of the dichroism of crystals.

**Royal Asiatic Society and India**

At the thirteenth anniversary meeting of the Royal Asiatic Society held on May 7, 1836, the Right Hon. C. W. W. Wynn (1775–1850), who had been president of the Society since its formation in 1823, in his address said that "He felt particular gratification in congratulating the meeting on the proposal which had been laid before the Society, for establishing a Committee of Agriculture and Trade in relation to the East. . . . The plan just alluded to would be the means of introducing into India the useful discoveries of Europe in arts and sciences, but in the encouragement lately given by government to a more extended and unrestrained intercourse with the East would be found the true efficient for these ends. . . . As the proposal relative to Trade and Agriculture must, if carried into effect, produce increased means of acquiring information on the capacity of the different nations of the vast Empire of India, he hoped it would meet with encouragement, not only from the Society, but from those engaged in commercial intercourse with the East." (*Athenæum*.)

## Societies and Academies

### Paris

Academy of Sciences, March 23 (*C.R.*, 202, 993–1124). Ernest Esclangon: The application of the principle of relativity to the study of a dynamical problem. Marcel Delépine and Alain Horeau: The hydrogenation of carbonyl compounds by Raney nickel, coated with metals of the platinum family. The influence of alkalis. The presence of a trace of alkali is essential for the hydrogenation. Experiments were made with ruthenium, palladium, osmium, iridium and platinum as coating for the nickel. All these metals increase the velocity of addition of hydrogen, palladium being the least active, platinum, iridium and osmium the most active. Ludovic Mrazec was elected *Correspondant* for the Section of Mineralogy, in succession to the late H. F. Osborn. B. Hostinsky: Probabilities in chain. André Weil: The overlapping of topological spaces: complete spaces, bicompact spaces. Nikola Obrechkoff: Asymptotic formulæ for Jacobi polynomials, and on the development along the polynomials. Karl Menger: Calculation of the variations in general spaces. I. Petrowsky: Cauchy's problem for a system of partial differential equations in the real domain. Pierre Rachevsky: A scheme unifying the theory of abstract groups with Lie's theory of infinitesimal groups. F. H. van den Dungen: Small movements of a system submitted to gyroscopic forces. Edgar Pierre Tawil: A piezo-electric chronograph. The instrument described is capable of measuring to 1/100,000 of a second. E. de la Villemarqué: The calculation of linear transformations, met with in astronomy, by the combined use of the machine and the method of mobile bands. L. Sackmann: The study of certain discontinuities in the experimental determination of the polars of [aeroplane] wings. Paul Schwarz: The Bénard-Kármán vortices behind an obstacle, in movement in a rectilinear canal. Louis Breguet: The optimum tonnage of large aeroplanes for use in transport or bombardment. Jean Delsarte: A problem of diffraction. Walter M. Elsasser: The diffraction of slow neutrons by crystalline substances. Pierre Jolivet: A new electrostatic motor. René Planiol: The ionisation and luminescence of atomic jets in a high vacuum. Moshé Feldenkrais: Measurement of the voltage of a Van der Graaf electrostatic generator with belts. G. Kravtzoff: The anodic behaviour of organic salts of copper. L. Néel: The influence of the thermal variation of the molecular field on the Curie constant. Thadée Peczalski: Widening of the lines of the radiation from 'singing' arcs. Charles Sannié, Lucien Amy and Vladimir Poremski: The isolation of the triplet 4358 A. of the mercury arc for use in obtaining Raman spectra. The filter proposed is a solution of nitrobenzene (6 per cent) and rhodamine 5G extra (0·01 per cent) in ethyl alcohol. Jean Roig: The temperature of helium in the high-frequency discharge. Although the conditions of the tube varied between wide limits, the temperature always remained in the neighbourhood of 200° C. Paul Soleillet and Serge Nikitine: The polarisation of the radiation 2139 A. emitted by the optical resonance of a jet of zinc atoms. René Audubert and M. Prost: A radiation emitted during the hydration and dehydration of quinine sulphate. An ultra-violet radiation, between 2500 A. and 2000 A. was proved to accompany these changes in water content. Mlle. Hoang Thi Nga: The influence of the nature and position of the groups on the photo-potential of the substituted aromatic amines. M. E. Nahmias: The artificial radioactivity of tin. A very slight artificial radioactivity has been produced in tin by irradiation with a radon-beryllium source. Mme. Emmanuel Zavizziano: Adsorption of protactinium by titanium, and the method of fractionation. Alex Sanielevici: Calorimetric measurements of the energy of disintegration in the actinium family. Marcel Lecoin: The continuous $\beta$-spectrum of actinium B. Raymond Lautié: A general constant of Van der Waals. J. Timmermans, M. Hennaut-Roland and D. Rozental: The variation of the volume of heavy water on freezing. The difference of the specific volumes of heavy water in the liquid and solid states is 0·0811: this gives as the rate of change of the freezing point with pressure 0·00705° C. per kilogram. Mme. Marie Elisa P. Rumpf and Paul Rumpf: The ultra-violet spectra of the bromine derivatives of aniline. Georges Carpéni: The dissociation constants of reductone and of its oxidation product with iodine. Jean Chédin: The quantitative analysis by the Raman effect of mixtures of sulphuric and

nitric acids. HENRI LEMONDE: Diffusion and azeotropism in binary mixtures. ALBERT PORTEVIN and PAUL BASTIEN: The mechanical resistance of the skin of alumina and its influence on the surface tension of the fused metal. MME. LÉONE WALTER LÉVY: Basic sulphocarbonate of magnesium. MAURICE DODÉ: Study of the reactions taking place during the absorption of nitrous vapours by solutions of potassium iodide. JACQUES BOURCART: Remarks on the Quaternary deposits on the Portuguese coast between Cap d'Espichel and the Peniche Peninsula. MLLE. MADELEINE FOURCHOY: The evolutive acceleration of the rootlets in wounded roots. YU CHIH-CHEN: A new technique analogous to the Feulgen reaction and its application to the study of the evolution of the nucleolar elements and satellites. M. and MME. FERNAND MOREAU: The action of the sugars on the Saprolegnieæ. EMILE PERROT: A new plant containing colchicine, *lofout*, a liliceaceous plant from the Sahara. MAURICE HOCQUETTE: Remarks on some characters of the secretion of *Primula obconica*. Evidence that the secretion in the cell and outside differ in composition. MME. CÉCILE SOSA-BOURDOUIL: Comparisons between some peas and their hybrids, relating to the elementary composition of the seeds. MARC SIMONET: New interspecific hybrids of *Iris Pogoniris*. MLLE. M. GAUTHIER: A new entophyte of the Harpellaceæ group, parasite of the larvæ of Ephemerids. GEORGES SOUCHÉ: The nucleus of *Diplocystis schneideri*. PHILIPPE JOYET-LAVERGNE: The localisation of vitamin A in the red corpuscles of the blood of the vertebrates in the course of the evolution of these globules. HENRI NOUVEL: Observations on abortive cells and the embryology of larvæ of the *Dicyemides*. MME. LUCIE RANDOIN and ROGER NETTER: Marked difference between the degree of necessity of vitamins A and B at a certain period of growth of the young rat, and in the case of a régime very rich in glucides. MLLE. LAIA OLSZYCKA: Quantitative study of the phenomena of synergy. Contribution to the study of the mechanism of the phenomena of potentialisation of hypnotic action in the rat. ANTOINE MAGNAN and HENRY GIRERD: Attempts at recording the successive attitudes of the wings of a pigeon and the corresponding variations of pressure. MME. VÉRA DANTCHAKOFF: The final result of a "female by hormonal induction". SERGE TCHAKHOTINE: Localised irradiation of the myoneme of the peduncle of *Vorticella* by ultra-violet micropuncture. JACQUES RABATÉ and JEAN DUSSY: Contribution to the study of the flavonolic heterosides of the fruits of *Sophora japonica*. PIERRE and CAMILLE CHATAGNON: The metabolism of bromine in the human organism. The tabulated results do not confirm the conclusions of Zondek and Bier. LOUIS COTONI and JACQUES POCHON: The titration of various therapeutic sera by neutralisation of the antibodies *in vitro*.

### BRUSSELS

Royal Academy (*Classe. Sci.*, December 7, 1935). L. GODEAUX: An algebraic variety in three dimensions of geometric genus zero and bigenus one. J. E. VERSCHAFFELT: Thermomechanics of the electric conductor (3). Reflections on the theory of the transverse magnetic effects. Comparison of the theory given in previous articles with the results of Sommerfeld and Franck. T. SOLOMOS: Probable shape of the cross-section of Saturn's rings. The consequences of assuming a hyperbolic shape for the rings are examined. P. VAN RYSSELBERGHE: The Le Chatelier-Braun principle and moderation theorems. R. LEDRUS: Probe measurements on the inverse alternation of mercury vapour rectifiers. Oscillographic studies. M. DÉSIRANT and J. DUCHESNE: Researches on the molecular spectrum of sulphur vapour. Extension of observations to longer wavelengths.

December 14, 1935. J. GÉHÉNIAU: Correspondence between gravitational fields and the fields of the wave mechanics. S. ARSITIDYSKY: Logical bases of the theory of probability (1). Theories founded on the notion of the limit of the relative frequency. M. KOURENSKY: Reduction of the integration of systems of non-linear equations of the first order with partial derivatives of several unknown functions to the integration of systems of linear equations of the first order of a single unknown function.

December 16, 1935. J. E. VERSCHAFFELT: Modern alchemy. H. BUTTGENBACH: Meteorites.

January 11, 1936. M. WINANTS: Both the two problems $a_0$, III, 3″ and $a_0$, III, 2′ can be solved by means of an integral equation with an infinite number of terms. G. FICHTENHOLZ: Linear operations in the space of continuous functions. G. DRINFELD: Integral invariants and contravariant functions. V. PÂQUET: The fundamental formula of the invariantive theory of the calculus of variations. O. ROZET: Some remarks on the deformation of quadrics. L. LONG: Some remarkable systems of curves on surfaces (3). L. MARTIN: On Bessel transcendents considered as Riemann functions relative to a class of systems of equations with partial derivatives containing as many equations as there are unknown functions of two independent variables. H. FREDERICQ: Changes of the action of the cardiac pneumogastric of the turtle produced by modifications of the *p*H of the heart.

### ROME

Royal National Academy of the Lincei (*Atti*, **22**, 275–365; 1935). U. CISOTTI: (1) Criterion for evaluating the dynamic forces acting on a circular obstacle containing a source and immersed in a translocirculatory current. (2) Calculation of the 'ballast effects' relative to a rectilinear lamina. M. BETTI and M. MANZONI: Anomalies in the dissociation constants of some halogenated organic acids (2). The dissociation constant of *o*-chlorophenylacetic acid ($1 \cdot 35 \times 10^{-4}$) is unexpectedly less than that of the corresponding bromo-acid ($1 \cdot 92 \times 10^{-4}$). G. CHECCHIA-RISPOLI: A Miocene formation from the Appennines of Capitanata. E. GUGINO: (1) Direction derivatives of tensors. (2) Cyclic transport of a tensor of any order. G. DOETSCH: Tricomi's formulæ on the polynomials of Laguerre. R. CACCIOPPOLI: Elliptical partial differential equations with two independent variables, and regular problems of the calculus of variations (1). U. BROGGI: Constants of Fourier-Laguerre. G. ASCOLI: A particular differential equation of the second order. L. SONA: Translocirculatory current which invests a bilateral lamina. Integral of the motion (3). L. GIALANELLA: Meridian observations of Uranus in 1934 and of Mars in 1935. E. MEDI: New method of analysis of partially polarised light diffused from the sky. G. GIRAUD: Passage of electricity in a magnetic field when the electrodes are points. G. NATTA and R. RIGAMONTI: Examination by electron rays of some fatty esters.

Long-chain compounds appear to show a two-dimensional isomorphism, which is independent of the active terminal groups and persists when $CH_2$ groups are replaced at long intervals by CO or by O. G. B. BONINO and R. MANZONI-ANSIDEI: Raman spectrum of some derivatives of pyrrole. All the alkyl-substituted pyrroles investigated give the two 'pyrrole ring' lines at 1,460–1,520 $cm.^{-1}$ and 1,370–1,390 $cm.^{-1}$. G. GOIDANICH: Observations on a rare disease of clover in Italy: anthracnose of *Kabatiella caulivora* (Kirchn.), Karak. M. MITOLO: Presence and distribution of reducing substances in brain tissue. Values are given of the reducing power of different parts of the brain tissue of toads, rats, pigeons, rabbits, cats, sheep, horses and oxen.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Monday, May 4

VICTORIA INSTITUTE, at 4.30.—Dr. H. C. Morton: "The Supposed Evolutionary Origin of the Soul".

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. G. T. Morgan, F.R.S.: Hofmann Memorial Lecture.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Baroness Ravensdale: "Persia in 1935".

### Tuesday, May 5

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Dr. F. L. Pyman, F.R.S.: "Recent Researches in Chemotherapy".

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. A. Butenandt: "Biochemistry of the Sterol Group" (succeeding lectures on May 7 and 8).*

INSTITUTION OF CIVIL ENGINEERS, at 6.—E. F. Relf: "Modern Developments in the Design of Aeroplanes" (James Forrest Lecture).

### Wednesday, May 6

ROYAL SOCIETY OF ARTS, at 8.—G. Mackenzie Junner: "The Oil Engine and its Influence on Road, Rail and Air Transport".

INSTITUTE OF METALS, at 8.—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—C. C. Paterson: "The Escape of Electricity from Metals: its Practical Consequences" (Annual May Lecture).

### Thursday, May 7

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Sir Edward Poulton, F.R.S.: "Ants".*

ROYAL VETERINARY COLLEGE, at 5.30.—Prof. Henry Dryerre and Dr. J. Russell Greig: "Mineral Deficiency Diseases of Farm Animals" (succeeding lecture on May 8).*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

Dr. E. Mallet: "Television—An Outline" (Faraday Lecture).

### Friday, May 8

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE UPON TYNE), at 6.30.—Dr. C. H. Desch, F.R.S.: "The Chemical Properties of Metals" (Bedson Lecture).

ROYAL INSTITUTION, at 9.—Sir William Bragg, Pres. R.S.: "The Electric Properties of Crystals (II)".

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IRON AND STEEL INSTITUTE, May 7–8.—Annual Meeting to be held at the Institution of Civil Engineers, Great George Street, London, S.W.1.

## Official Publications Received

### Great Britain and Ireland

County Borough of Southport: Meteorological Department: The Fernley Observatory, Southport. Report and Results of Observations for the Year 1934, with an Appendix. By Joseph Baxendell. Pp. 32. (Southport: Fernley Observatory.) [303

The Nutritive Value of Milk. Memorandum by the Advisory Committee on Nutrition, issued by the Ministry of Health and the Department of Health for Scotland. Pp. 12. (London: H.M. Stationery Office.) 3d. net. [303

Ministry of Health. Costing Returns, Year ending 31st March 1935. Pp. 24. (London: H.M. Stationery Office.) 1s. net. [303

Rothamsted Conferences. 21: The Use of Electricity in Agriculture: being a Report of a Conference held at Rothamsted on January 29th, 1936, under the Chairmanship of Sir Bernard E. Greenwell. Contributions by Sir E. J. Russell, M. M. Harvey, B. A. Keen and G. H. Cashen, F. E. Rowland, C. A. Cameron Brown, and others. Pp. 77. (Harpenden: Rothamsted Experimental Station.) 2s. [14

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1935. (No. 84.) Pp. 94+8 plates. (Marlborough: Marlborough College.) 5s.; to Members, 3s. [14

Development Commission. Twenty-fifth Report of the Development Commissioners, being for the Year ended 31st March 1935. Pp. 141. (London: H.M. Stationery Office.) 2s. 6d. net. [14

Interim Report of the Departmental Committee on the Ordnance Survey. Pp. 16. (London: H.M. Stationery Office.) 3d. net. [24

The Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 1: Factors influencing the Loss of Butterfat in Churning. By J. Lyons and M. O'Shea. Pp. 18. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. [24

### Other Countries

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig. Zweite Serie: Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium. Band 7, Heft 1: Die Singularität im Druckverlauf Ende November, ihr innerer Aufbau und ihr Einfluss auf den Temperaturverlauf Europas im Dezember (Weihnachtstauwetter). Von Fritz Engelmann. Pp. 52+16 maps+3 plates. Band 7, Heft 2: Horizontale und vertikale Staubverteilung in einer Grossstadt. Von Alfred Löbner. Pp. 53–100+9 plates. Band 7, Heft 3: Zur Theorie der Luftspiegelungen insbesondere des elliptischen Falles. Von Wolf-Egbert Schiele. Pp. 101–188. (Leipzig: Geophysikalischen Institut.) [14

U.S. Department of Agriculture. Circular No. 381: Rodents and Moles as pests in Bulb Plantings. By Theo. H. Scheffer and F. E. Garlough. Pp. 16. 5 cents. Technical Bulletin No. 504: *Orius insidiosus* (Say), an Important Natural Enemy of the Corn Ear Worm. By G. W. Barber. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.) [14

Smithsonian Miscellaneous Collections. Vol. 95, No. 2: Lethal Effect of Short Wave Lengths of the Ultraviolet on the Alga *Chlorella vulgaris*. By Florence E. Meier. (Publication 3380.) Pp. 19+2 plates. Vol. 95, No. 3: Liquid-Propellant Rocket Development. By Robert H. Goddard. (Publication 3381). Pp. 10+11 plates. (Washington, D.C.: Smithsonian Institution.) [14

Koninklijk Nederlandsch Meteorologisch Instituut. No. 115: Oceanographische en meteorologische Waarnemingen in de Chineesche Zeeën en in het Westelijk Deel van den Noord Stillen Oceaan. 1: Maandkaarten voor Januari–Juni (1910–1930). Pp. 46. ('s-Gravenhage: Rijksuitgeverij.) 7.50 fl. [14

League of Nations. Bulletin of Information on the Work of International Organisations. Compiled by the Section of International Bureaux. (No. 2, Vol. 7.) Pp. 93–206. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) [34

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 19: Obras póstumas y truncas. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 1042. (La Plata.) [64

Osiris. Vol. 2, Part 2: Speech Consciousness among Egyptians and Babylonians. By Henry Frederick Lutz. Pp. 27. (Bruges: Saint Catherine Press, Ltd.) [64

The Parliament of the Commonwealth of Australia. Ninth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1935. Pp. 108. (Canberra: Government Printer.) 4s. 3d. [64

Studja nad Bocianem Białym w Polsce (Studies on the Stork (*Ciconia ciconia* L.) in Poland.) 2: Bocian na Polskim Śląsku (The Stork in Polish Silesia). By Kazimierz Wodzicki. Pp. 20. 3: Bocian w Województwie Lwowskiem (The Stork in the Voivodeship of Lwów). By Kazimierz Wodzicki. Pp. 44. (Kraków: Państwowej Rady Ochrony Przyrody.) [74

Państwowe Muzeum Archeologiczne. Wiadomości Archeologiczne, Odbitka z tomu 13: Studja nad Prehistorycznemi Psami Polski (Studien über vorgeschichtliche Hunde Polens). By Kazimierz Wodzicki. Pp. 74+7 plates. (Warszawa: Państwowe Muzeum Archeologiczne.) [74

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### Catalogues

Hortvet Cryoscope. (Circular No. 277B.) Pp. 2. Chemical Products. (Pamphlet No. 287.) Pp. 4. Useful Laboratory Requisites. (Circular No. 304.) Pp. 2. Humidity Controlled Cabinet. (Circular No. 306.) Pp. 2. (London: A. Gallenkamp and Co., Ltd.)

Books on Botany, Gardens and Gardening, Forestry and Agriculture, with a section of Herbals. (Catalogue No. 599.) Pp. 84. (London: Francis Edwards, Ltd.)

Chemie, Physik. 14 Verzeichnis antiquarischer Bücher und Zeitschriften nebst Novitätenliste. Pp. 32. (Berlin: Verlag Chemie, G.m.b.H.)

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# War, Science and Citizenship

FIELD-MARSHAL LORD ALLENBY, in his rectorial address delivered at the University of Edinburgh on April 28, when he was installed as Lord Rector of the University, gave the students a noble message for the future of humanity. He condemned war between nations in unmeasured terms as futile in itself and perilous to the highest needs of civilisation. "Wars," he said, "have been usually waged for the spoils of victory, increase of territory, acquisition of wealth, even glory to the victor. The lust for expansion is not yet dead, but the glory of conquest is departing, its gains are Dead Sea fruit, its legacy bitter memories alone. We find the cleverest brains everywhere busily experimenting with new inventions for facilitating slaughter, building more horrible engines of destruction, brewing more atrocious poisons, designing more monstrous methods of murdering their fellow-men and women. . . . Governments, distrusting treaty makers, no longer hold treaties in respect, regarding them as merely temporary makeshifts."

The use of poison gas in Abyssinia, and the unprovoked attack upon the country, are examples of a breach of covenant and disregard of international obligations which have been condemned by all civilised peoples. These outrages on humanity have raised again the question of the association of science with war and the prostitution of scientific effort to war purposes. No scientific worker will underestimate the difficulties which confront the Italian chemists who reprobate the abuse of scientific knowledge and work in this manner in a State where freedom of scientific thought and effort have long been proscribed. The danger and the problem are, however, far from being confined to Italy. We need look no further than the preparations for national defence stimulated by the British Government in pursuance of the policies outlined in the White Paper on Defence, and the activities in respect of aerial defence which are outlined in the handbooks on Air Raid Precautions being published by H.M. Stationery Office.

Individual manufacturers and local councils are participating in these preparations, if only through the fear of incurring the anger of those who did survive if no precautions had been attempted. Besides this, however, professional and other associations of scientific workers are being led to participate in various ways; and the responsibility which lies on such associations is far greater than that which rests on the non-technical or non-scientific municipal or district council or manufacturer. Despite the action of individual scientific workers, it is disheartening to find that no association of scientific men has yet had the courage to express a frank opinion on the exact value of this effort and the security it can confer.

There is no more disturbing sign in the present situation than the absence of such an authoritative pronouncement, with the social outlook and acceptance of civic responsibility which it implies. While most scientific workers would not wish to avoid participating in the task of national defence, and in so doing to see that the highest possible efficiency is secured, they would be disloyal to their trust if they do nothing to prevent the creation of a sense of false security, or to make known the extent to which authoritative and expert opinion regards defence against aerial bombardment, whether by incendiary, high explosive or gas bombs, separately or simultaneously, as practicable.

To neglect all precautions would be foolish, but scarcely more foolish than allowing the population to believe that effective defence is possible, or to remain ignorant of the acute dangers which would attend the severing of, for example, the Great London sewer at Barking or the new Mersey tunnel, and the extreme vulnerability of such points to high explosive or gas bombs. Moreover, since complete defence is impossible, authorities have recognised that victory in the next war will go to the country whose population and industrial organisation show the greatest degree of staying power and endurance. Accordingly, populations are being trained and organised to develop staying power and endurance, and the scattering of individuals and industries to enhance staying power has already begun in some of the threatened countries, with consequences to social amenities and the preservation of natural beauty which may be irreparable, as they are for the present disregarded.

The misdirection of scientific effort and national resources in this way is in itself a threat to the continuance of civilisation almost as serious as the outlook of the very warfare against which the precautions are being developed. It is not merely the appropriation in this way, for defence purposes which are largely futile, of large sums of money which might otherwise enable the mass of the population to enjoy that measure of plenty with which science could well endow them. At a recent meeting held in London, Sir John Orr and a group of engineers and other scientific workers assessed the unfulfilled needs of the people of Great Britain with regard to prime human necessities such as food, housing, clothing, health and recreation, at about £3,000,000,000 a year, including a sum for essential foods of £200,000,000, which is roughly the cost in goods and services of the activities now being organised with immense care and skill to meet the artificially created danger of aerial bombardment.

Much more serious is the steady deterioration of life which always occurs under a military regime, and to which Lewis Mumford directed attention in a brilliant chapter in his "Technics and Civilisation". Under such a regime, the re-orientation of civilisation so that the creative forces of society are fully utilised, and mechanisation is the agent and not the master of mankind, becomes more than ever impossible of attainment. Nor can we hope either that technical developments will be made to conform to the elementary spiritual needs of mankind or for the successful elimination of the causes of cultural decay which to-day present an evergrowing menace to the spiritual and æsthetic elements still left to our civilisation.

Whether anything worth preserving can long remain in our civilisation under its present conditions and leadership may well be open to doubt. In a speech at Worcester on April 18, the Prime Minister spoke of the probability of the outraged peoples turning against Governments which allowed the use of poison gas in a European war, after hostilities had ceased. That rising against wickedness in high places may well be much nearer. The ordinary citizen has much to lose by mere acquiescence to the drift of present conditions, in which a dangerous premium is put on revolution and violence. Only constructive statesmanship can avert either revolution or disaster, and in that statesmanship men of science must play their part.

Even the dullest cannot fail to see what is involved in the cynical disregard of international conventions shown by Italy's use of poison gas against a nation utterly unprovided with any means either of defence or reprisal in kind. This shattering of faith in international pledges is accentuated by the evident reluctance of powerful members of the League of Nations to resort to effective means of restraining the aggressor, and the consequences of such default may be far-reaching. The alternative to collective security resolutely enforced is so terrible that it would be rash to predict that any intelligent people will indefinitely allow their rulers to repudiate or disregard their international obligations and plunge all alike in a catastrophe from which there may be no recovery.

Scientific workers should pause to consider whether even yet there is not some decisive contribution which collectively they might make to remedy this condition of our so-called civilisation. It is deplorable that so much effort continues to be expended on destructive purposes while the great constructive enterprises, which might enable mankind to enjoy more fully the great resources with which science has endowed us, remain crippled or uncommenced for lack of funds.

The choice before us could scarcely be better expressed than has been done by Mr. H. A. L. Fisher in his recent "History of Europe": "The developing miracle of science is at our disposal to use or to abuse, to make or to mar. With science we may

lay civilisation in ruins or enter into a period of plenty and well-being, the like of which has never been experienced by mankind".

To acquiesce tamely in the present situation is a policy of despair and will assuredly involve scientific workers in the destruction to which civilisation is steadily drifting. To ally themselves boldly with constructive political forces, to apply the spirit and method of science to the elaboration in the political and social spheres of ways and means of control, of relating power to knowledge, may yet avert disaster and enable the world to reap the advantages which are still within its reach. To do so, however, demands courage, and vision, resource and pertinacity the equal of any which has yet been shown in pioneering investigations in those fields of knowledge within which science has hitherto been largely content to limit its activities.

# Modern Methods in the Antarctic

Antarctic Discovery: the Story of the Second Byrd Antarctic Expedition. By Rear Admiral Richard Evelyn Byrd. Pp. xxii+421+47 plates. (London: Putnam and Co., Ltd., 1936.) 18s. net.

THANKS to the restraint on publicity imposed by the practice of exclusive copyright in news, most English newspaper readers have been kept nearly as ignorant of Admiral Byrd's second expedition to Little America as of the financing of Irish hospitals or evidence in the divorce courts. As a result there has been a vague impression that the expedition was a lavishly equipped pleasure trip intent on photographing films of sensational stunts and making exaggerated claims to amazing discoveries. It is for this reason that I welcome the opportunity of reviewing Admiral Byrd's book and endeavouring as far as I can stretch the allotted space to direct attention to the solid achievements of the expedition.

It must be acknowledged that the book presents some initial difficulties to the reader accustomed only to English books of travel, but these are soon overcome. The chapter headings give little idea of the subjects dealt with; but a good index goes far to remedy the deficiency. The book is a straightforward narrative vividly and tersely written. The meaning of certain American neologisms can be divined from the context, and even such a cryptic phrase as "commuting to work back home" glimmers into comprehensions as a simile for the monotonous repetition of daily drudgery.

We learn that, like most of our own explorers, Byrd had a hard and distasteful struggle to raise funds and collect stores. He had to be content with two indifferent ships, an old wooden whaler, the *Bear of Oakland*, and a common steel tramp, the *Jacob Ruppert*. On the way out, the latter vessel escorted by a scouting seaplane reached higher latitudes in the South Pacific than had been attained before. This enables the cartographer to push nearly the whole Pacific coast-line of Antarctica south of 73° S. We notice that the name Marie Byrd Land, given in Admiral Byrd's earlier book "Little America" to a modest area south of King Edward VII Land, is now stretched across the whole great lobe between the Pacific Ocean and the Ross and Weddell Seas.

At the Bay of Whales 400 tons of stores were landed and transported several miles to Little America. The old buildings were found intact, deeply buried in snow on which the new buildings were erected, soon to be drifted over in their turn. The two levels were connected by steep tunnels and a population of 55 men, twice as many dogs and several cows was settled for the winter entirely underground. The extent of this catacomb 'city' was so great that Dog-town alone consisted of eight parallel tunnels, each 100 feet long, 6 feet high and 3 feet wide, with each dog tethered to a crate let into the walls on either side out of reach of its neighbours. The whole was burrowed in a cake of ice probably about 300 feet thick and floating on 600 fathoms of water. In fact, it was a potential iceberg, and a system of crevasses made its permanence very questionable until winter moored it fast.

An advanced base 120 miles to the south (in 80° S.) was occupied for the winter by the leader alone, a somewhat surprising arrangement. It was Admiral Byrd's expedition; he was entitled to conduct it as he thought best, and as it was a success the event justified the plan.

"The truth of the matter is," Byrd writes, "I really wanted to go and keenly looked forward to the experience. . . . I sincerely believed I was as interested in the experience for its own sake as I was in the meteorological work for which the Base was designed. Therefore I cannot say that I was making a sacrifice for science. That did not

enter my head. As for leaving the camp without a leader, well, I had confidence in the officers and men at Little America."

Communication by wireless telegraphy was kept up with the leader, and every unit in the field with dogs, tractors or by air were always "contacted" with the Base. Although nearly poisoned by fumes from his stove, Byrd survived the ordeal. Dr. Poulter, his second in command at the Main Base, fell ill with acute appendicitis. He was operated on and his life saved by Dr. Potaka, the clever Maori doctor who had been brought by the *Discovery II* in a dramatic feat of seamanship when the American surgeon resigned immediately after landing.

Exploring work was carried out before and after the winter of 1934 by all three means of transport. The dogs worked well, especially on the great three months' journey of the geological party due south to an elevation of 8,000 feet in the Queen Maud Mountains in 87° S., a total distance of 1,400 miles out and home. Fossils were obtained in great numbers and beds of coal located on the huge rock faces of the mountains. Living lichens were found in the crevices of the rock at the farthest point. Dogs did their full share in the transport of loads between the ships and Little America, but they could not face the extreme cold of winter when temperature fell to − 70° F. or lower.

The tractors bore the brunt of the transport service, and although it was a tremendous task to start the engines, they made the journey to the advance base to the relief of Admiral Byrd in the mid-winter darkness of July. The distance run by tractor amounted to 11,000 miles, which included long journeys along the eastern margin of the Barrier partly on the Ross Ice Shelf and partly along the western slope of the Rockefeller Plateau, often in heavily crevassed country. They were demonstrated to be the most effective of all the forms of polar transport when a sufficient force of skilled mechanics and ample supplies of fuel were available. The troubles of camping were enormously reduced by using the cabins instead of pitching tents to sleep in.

For speed and range, however, the aeroplane easily took the first place. There was a strong fleet of aircraft, from a small auto-giro used for taking meteorological observations at high levels, to the great Condor weighing 8 tons with a wing-spread of 82 feet. The handling of these machines was one of the chief triumphs of the expedition. They had to be housed for the winter in pits dug in the snow where they were soon drifted over. This work, together with the delicate task of digging them out unhurt in the spring, was scarcely less remarkable than the 16,000 miles of flying which they accomplished when in the air. The aeroplanes were often used to lay out depots in advance and to replenish the supplies of the surface parties. The principal exploring journeys by air were into the mass of Marie Byrd land for distances up to 500 miles in straight flights to south-east, east and north-east respectively, the last bearing being along the coast.

In his popular narrative, Admiral Byrd speaks lightly of surveying hundreds of thousands of square miles, but he uses the word as Cowper made Alexander Selkirk say, "I am monarch of all I survey". In the note on maps, the claims are set forth with scientific moderation, and it is explained that there has not yet been time for all the cartographic material to be tested and worked out. The preliminary maps, however, show in an impressive way how greatly this and the earlier expedition have added to the knowledge of the eastern borders of the Ross Ice Shelf. The eastern coast of the ice-filled gulf has been roughly mapped for the first time. It is less mountainous than the western and southern margins, but is clearly marked by the rising slope to the Rockefeller Plateau.

Much new light was thrown on the nature of the Ice Shelf itself by seismic echo-sounding. Although the northern edge of the Barrier was afloat in deep water, the ice proved to be aground at many points in the interior, separated by crevassed belts from the floating portions. The probability of a sea connexion between the Ross and the Weddell Seas has been much diminished. If there is any, it can only be by a comparatively narrow and winding strait.

Apart from the important geographical discoveries and the geological collections, substantial scientific researches were undertaken in biology and physics, which, if fully discussed, should prove valuable. Plankton, for example, was collected from various depths in the Bay of Whales in winter until the sea ice had thickened to more than five feet, and at air temperatures of − 40° or less the contents of the tow-net were transferred to vacuum flasks and carried unfrozen to the laboratory. Regular photographic magnetic records and meteorological observations were made on the surface and in the upper air at the main base and for several months at the advance base also. Cosmic radiation was studied, and a novel feature of the scientific programme was the continuous record of meteors during the winter night at Little America and for some time at the advance base.

Admiral Byrd is to be congratulated on the success of a great venture in which foresight and good management overcame all the risks and hardships of the very severe conditions encountered.

HUGH ROBERT MILL.

# Mr. Keynes and the Rate of Investment

**The General Theory of Employment, Interest and Money**
By John Maynard Keynes. Pp. xii+403. (London: Macmillan and Co., Ltd., 1936.) 5s. net.

FOR more than a century the problem of unused resources has occupied a conspicuous place in economic investigation, yet much remains to be done in a field of great intellectual difficulty. A large part of Mr. Keynes's own previous work, not least his important two-volume "Treatise on Money" published in 1930, has been occupied with this and allied topics. His present rather startling volume tears to pieces some portions (not always the weakest) of his earlier work, amends other portions and supplies much new analysis. In dealing with short run changes in the level of activity, the most important factors to consider are, of course, those which determine the rate of new investment—factors already analysed at some length in the author's "Treatise". He now believes, however, that the main weakness of his earlier analysis was that it relegated changes in aggregate output and employment to a secondary position, and involved a definition of income which was not the most convenient one. These defects it is the purpose of the present book to remedy.

Nevertheless, it should not be thought that the "General Theory" is in any sense a mere revision of the "Treatise"; for cyclical movements of activity now occupy a much smaller part of the picture. Instead of an alternate excess and deficiency of 'effective demand' (aggregate money demand for total output), Mr. Keynes now believes in the existence of a chronic tendency for it to become deficient. His analysis differs from that of the cruder underconsumptionists in that the trouble is imputed not to excessive, but to continuously insufficient investment. The failure of investment to come up to a level which would secure full employment is due, he explains, to the unwillingness, owing to institutional frictions, of the rate of interest to decline adequately. Each level of interest rates represents a perfectly stable equilibrium, and is correlated with a volume of unemployment, which is larger, the higher is the level of interest rates above a critical minimum. This critical minimum corresponds to full employment; if the rate of interest is forced down below this minimum the resulting increase of investment results merely in rising prices, and a state of 'true inflation' develops. Only after full employment is reached is there any danger of the situation becoming unstable. Certain obvious practical conclusions emerge: the proper way to attack unemployment is not by lowering money wages (which is anyway impracticable) but by governmental measures to expand investment, or (better still) by direct measures (central banking or otherwise) to lower the prevailing level of interest rates. The argument also leads to an unreserved condemnation of the gold, or any other international, standard, since such a standard destroys national autonomy in interest rate policy.

It may be that many readers will think there is more to be said in favour of classical economics than Mr. Keynes allows: he seldom takes Ricardo and his followers on their own ground. It may be, too, that some readers will think the writings of several of the author's contemporaries scarcely deserve the asperity which is accorded them. But it is plain that the book will stand or fall by the relevance to real life of its central (and it should be realised highly unconventional) thesis outlined above. Mr. Keynes's main difference from other writers has to do with his judgments concerning the stability of the rate of investment. The crucial question may be put as follows: Is it possible by lowering interest rates to raise the current rate of investment by some defined amount, without releasing a tendency for investment to go on expanding? Or if this is possible, but only possible within certain limits, what are these limits? According to the "General Theory", these limits are set by that rate of investment which yields full employment. But many readers will undoubtedly feel that no sufficient grounds are advanced for believing that expansions of investment are non-cumulative on one side, and cumulative on the other side, of full employment. In effect, Mr. Keynes relies on the short run inelasticity of the supply of capital goods, coupled with the decline in their physical marginal product as they become less scarce, to save him from instability in the rate of investment. But the decline in the supply price of capital goods, as the resources for producing them are increased, will further stimulate investment. To argue that this tendency will be neutralised (within relevant periods of time) by a fall in the physical marginal product of these goods, is surely to lose all contact with reality.

The problem can also be posed in another way. Mr. Keynes develops 'multipliers' to relate the total increments of investment and employment, respectively, to the initial increments in these

quantities induced (say) by a dose of governmental loan expenditure. The multiplier is obtained in each case by summing the secondary, tertiary and other increments which follow as a result of the primary increment. In order that the multiplier shall be finite, or (put otherwise) in order that any tendency to *cumulative* expansion in the rate of investment and danger of ensuing crisis shall be absent, these increments must form a convergent series. But do they? This is a point that Mr. Keynes has scarcely argued; and that he should not have done so is all the more curious since most writers in the past have urged, both a priori and from experience, that, at any rate outside narrow limits by no means necessarily coincident with full employment, the series in question do *not* converge.

The practical question remains whether 'full employment' can be secured in a system of private enterprise merely by operating upon the rate of interest. As Mr. Keynes justly remarks in his preface, "the matters at issue are of an importance which can not be exaggerated". He writes for a technical audience, and since his conclusions disagree with the results of most recent thinking on the subject, the sooner other economists decide whether it is they who are on the wrong side of the looking-glass or he, the better it will be. It scarcely needs saying that the book is written with charm and insight, and like everything from the author's pen has a frankness and an aptness of expression which are often disarming. Much of the book is highly original, and all of it is stimulating; especially penetrating and fruitful are the chapters on the long-term expectation and on the properties of interest and money. But on the fundamental problem, those readers may perhaps be pardoned who decide that the "Treatise" remains a safer, if a less ambitious, guide.

HAROLD BARGER.

# Fuels and Fuel Economy

**Fuel:**
Solid, Liquid and Gaseous. By J. S. S. Brame and Dr. J. G. King. Fourth edition. Pp. xvi+422. (London: Edward Arnold and Co., 1935.) 25*s*. net.

THE subject of fuel grows in political, economic, technical and scientific importance. Though wood is no longer in the picture in competition with coal, oil is very much so. Raw coal is being displaced by coke, by low-temperature fuel and particularly by gas—either coal gas, or coke oven, producer, blast furnace, or water gas—and indeed should never be burnt as such. Liquid fuels are extending in every field of use; they include fuel oil, Diesel oil, petrol, tar, benzol and alcohol.

There is a large volume of technical and scientific knowledge available about these fuels, their properties and the methods of testing them, which is increasing every day, though it is far from being as widely spread as is desirable, particularly among engineers and fuel users in general.

Such books as the one before us are calculated to help greatly in developing the economic use of the most suitable type of fuel for any particular purpose. It is well to emphasise that fuel costs enter into the cost of every manufactured article, sometimes, as in the heavy industries, in transportation, and in certain chemicals to a very large extent. If manufactured articles are to be competitive, the fuel costs must be kept low, with the result that as the prime cost of a fuel increases, there is every incentive to burn it more economically and therefore to a less extent. Those connected with the coal trade remain obstinately blind to this fact.

Fuel efficiency as a science is as yet in its infancy, and relatively few firms have whole-time fuel officers. In many industries this officer should be one of the most important of the staff, and it behoves our training centres to produce an adequate supply of them. Raw coal has had its day; the open grate fire is only useful to inspire poets and to counteract depression. Coal should be first distilled for its valuable products and ultimately burnt in forms which keep the tar and smoke and sulphur out of the atmosphere.

The actual loss of combustible matter in the smoke even of a domestic fire is far smaller than is supposed, and by far the greatest saving in an industrial boiler is effected by reducing the amount of air so that the flue gases contain a maximum of carbon dioxide. It is the escaping sulphur which is the real problem, which now requires dealing with drastically in our cities.

This is a fourth edition, a testimony that the authors know their subject, though it has needed a good deal of bringing up to date since progress is so rapid. This is particularly true in connexion with the poorer gaseous fuels. The book is

conveniently divided into four sections dealing with solid, liquid and gaseous fuels respectively and with their analysis and calorimetry.

It is clearly printed and well illustrated with drawings, graphs and tables, and contains a deal of practical information on every section of the subject set out in a manner which should be readily intelligible to the practical engineer and works officer. Its possession and the application of the information it contains should help to advance the cause of fuel economy: in this connexion we would again emphasise the desirability of the employment of full-time fuel economy experts by large firms. E. F. A.

# Some Aspects of Eugenics

(1) Constructive Eugenics and Rational Marriage
By Dr. Morris Siegel. Pp. xiii+196. (Toronto: McClelland and Stewart, Ltd., 1934.) 2.50 dollars.

(2) The Chemical Control of Conception
By Dr. John R. Baker. With a Chapter by Dr. H. M. Carleton. Pp. x+173. (London: Chapman and Hall, Ltd., 1935.) 15*s*. net.

(1) DR. SIEGEL'S small volume has been written for the average reader who may wish to learn something about the science of eugenics. Following a short chapter on the laws of heredity, the author opens his main theme, which is that the number of defectives in proportion to sound stock in a population is steadily increasing, owing to the prevalence of what may be called faulty mating; and it is the author's object to indicate how it should be possible to ensure proper and suitable unions.

For the preservation of the race, it is essential in the author's opinion that steps be taken by society to prevent breeding from unhealthy stock. As it happens, in certain instances great men and great women have arisen from a bad stock, so that it is impossible to insist upon a wide programme of sterilisation as a general method of improving the human stock. Dr. Siegel therefore advocates an extensive educational programme which would involve the compulsory teaching of eugenics in higher schools, more extensive instruction in heredity and eugenics for medical students, post-graduate courses for the training of specialists and widespread propaganda. The author emphasises that good stock is not synonymous with the so-called upper classes, and quotes many instances of famous men and women who have risen from the masses.

Dr. Siegel's book is written in a popular manner, but suffers from the disadvantage that the political outlook is not always applicable to conditions in Great Britain.

(2) Touching on this subject from a different angle is the question of birth control, which may play an extremely important part in the future in regulating over-population and so the pressure of peoples outwards, beyond their frontiers. Moreover, in modern civilisation it is often considered essential to control the frequency of births in families, or even to prevent them altogether. Chemical methods of contraception are frequently practised, but little scientific work has been carried out on the subject, so that Dr. Baker's book fills a distinct gap.

Dr. Baker uses the spermatozoa of the guinea pig on which to test the effect of contraceptives. The spermatozoa can be maintained alive in different fluids, such as phosphate or acetate glucose-saline, or a solution of egg white in saline or phosphate. The author has found that it is best to determine the lowest concentration in which a substance under test kills all the spermatozoa in a standard time rather than to find out how long the spermatozoa take to die in a standard concentration. Most substances have little or no effect upon spermatozoa in one-eighth of the concentration at which they immobilise every time. The most potent compounds found were certain quinones, which immobilise in a concentration of 1/512 per cent. At the end of the scale come resorcinol and chloral, which only immobilise in a concentration of 1 per cent. The alkaloids harmine and ethylharmol are weakly active: quinine salts are less potent. Human spermatozoa react in almost the same way as those of guinea pigs, but germicidal power is not a reliable indicator of spermicidal activities.

Unfortunately, however, the most active compounds are irritant to the vaginal wall. In fact, it appears that a really potent chemical contraceptive which is also devoid of any pathological effects has yet to be found. In the course of the experiments, it was noticed that certain of the compounds at certain concentrations stimulated the activity of the spermatozoa, and it is suggested that strychnine in dilute solution should be used in human beings where sterility is due to feeble motility of the spermatozoa. The book gives a detailed account of the experiments carried out and should be of the greatest value to all those engaged in investigating the usefulness of contraceptives.

**Confessions of a Ghost-Hunter**
By Harry Price. Pp. 396+16 plates. (London: Putnam and Co., Ltd., 1936.) 10s. 6d. net.

THIS volume is a further series of accounts by Mr. Price of his experiences when investigating alleged supernormal phenomena. In the course of his remarks he ranges over a wide field, and thus the records are somewhat unequal in value. Thus, on one hand, space is given to accounts of the performances of palpable frauds; and on the other, we find interesting chapters which contain records of experiments with persons well worth serious attention, like the vaudeville telepathist, Fred Marion. From the scientific point of view one of the most interesting chapters is that dealing with 'spirit' photography, in which Mr. Price details a number of ingenious methods for producing these fraudulent results. From this account it will be seen how valueless reports by untrained and uncritical persons must be, and how difficult is any serious investigation of such claims.

Apart from accounts of these rather dubious manifestations, the book contains a good deal of topical material of importance to psychical researchers, including a résumé of the forthcoming report of the University of London Council for Psychical Investigation on experiments with a subject who exhibited unusual hyperæsthesia; and a summary of the recently staged fire-walk by Mr. Kuda Bux. In this latter case, where the same performer claims to be able to read blindfolded, Mr. Price is of the opinion that this exhibition of eyeless sight is "extremely interesting, entertaining and puzzling", a somewhat startling conclusion, seeing that he himself admits that Bux will not allow the investigators to prevent him seeing down the sides of his nose.

**For and Against Doctors:**
an Anthology. Compiled by Robert Hutchison and G. M. Wauchope. Pp. 168. (London: Edward Arnold and Co., 1935.) 7s. 6d. net.

DRS. ROBERT HUTCHISON and G. M. Wauchope have fished in all the waters of literature for evidence of the world's opinion of its medical advisers. The feast which they have prepared from their catch is salted with wit and strongly spiced with mustard and pepper. The dishes vary in length from simple statements like "I abhor physicians" to a quotation from Molière occupying three pages. The material is divided chronologically into chapters, and each chapter is prefaced with a summary of its contents. The authors believe that the praise and the dispraise pretty well cancel out. Gravimetrically this may be true, but volumetrically there is more abuse than homage. There is evidence that increase in medical skill has been accompanied by an increase in the reputation of doctors. The first quotation from the "Ancients" states that "the best of doctors is ripe for Hell". The last word of the "Moderns" is that "If a doctor's life may not be a divine vocation, then no life is a vocation, and nothing is divine".

**Abraham:**
Recent Discoveries and Hebrew Origins. By Sir Leonard Woolley. Pp. 299. (London: Faber and Faber, Ltd., 1936.) 7s. 6d. net.

IN writing this study of Abraham, Sir Leonard Woolley evidently had in mind the class of readers who seek in archæology evidence which will confirm Bible narrative. As he is careful to explain at the outset, his work of excavation in Mesopotamia has produced no concrete evidence of the presence of Abraham at "Ur of the Chaldees"—in any event the epithet is an anachronism. He maintains, however, that the knowledge of the civilisation of Ur, which has been acquired by excavation in the years in which the joint expedition, of which he was leader, was engaged on the site, both explains and expands the Biblical narrative. If Abraham as a young man, and the people of whom he was the leader came from Ur, the patriarch may fairly be regarded as something more than the leader of a nomad bedouin tribe. He and his people had been in contact with the civilisation of a Sumerian city; and to this contact may be ascribed certain peculiarities in the behaviour of Abraham, such as his treatment of Hagar and Ishmael, and certain distinctive characteristics in Hebrew law and religion, which appear with a clearly perceptible change in the character of the historical narrative when Abraham comes on the scene. The Biblical narrative, therefore, Sir Leonard concludes, is substantially accurate. The argument is stated with much force, and the clear and succinct account of the civilisation of Ur brings into due prominence the resemblances which the author finds in the two cultures.

**Einführung in die deutsche Bodenkunde**
Von Prof. Johannes Walther. (Verständliche Wissenschaft, Band 26.) Pp. viii+172. (Berlin: Julius Springer, 1935.) 4.80 gold marks.

THIS book, by a well-known German geographer, is a popular account of the author's views on the geomorphological history of German soils. He sets out to describe the varying climates that have prevailed in Germany since post-Cretaceous times, and their effect on the deposition of soil material and on the plant and animal life. The greater part of the book is naturally concerned with a description of the conditions that prevailed during the Ice Age and their effects on the present-day landscape. He is barely concerned with the details of the chemical weathering of the soil material that has taken place since it was laid down in its present position. Thus the book should be complementary to the usual books on soil formation.

Unfortunately, the usefulness of this book for English readers is limited, for the author justifies very few of the statements made, as it is primarily a popular account of his views. It is thus difficult to distinguish between those statements that are generally true and those that are only applicable to parts of Germany, or between the ideas held by the author and those that are generally accepted.

E. W. R.

# The Cavendish Laboratory, Cambridge

## Benefaction by Sir Herbert Austin, K.B.E.

THE benefaction of approximately £250,000 by Sir Herbert Austin for the future work of the Cavendish Laboratory satisfies in a most handsome way one of the urgent needs of the University of Cambridge.

In recent years, developments in physics have changed the requirements of experimental physicists from the glass tube and electrometer of an earlier generation to apparatus such as the two million volt generator, the 50-ton magnet or the cryogenic laboratory. The initiation in Cambridge of new fields of work involving such apparatus has been made possible by the support of the Department of Scientific and Industrial Research, by generous help from the Royal Society and by special grants from the University. Inevitably, however, it would have been difficult for the University to provide from its limited resources for a continuation of such developments in the future, and for some time the need of research endowment has been strongly felt.

Not only have funds been required for research purposes, but also far-reaching reconstructions of the buildings of the Laboratory have also become necessary. The oldest wing of the Cavendish Laboratory was built under the close personal supervision of Clerk Maxwell between 1871 and 1874, the cost being defrayed by the seventh Duke of Devonshire, then Chancellor of the University. The Laboratory, built in a restrained Gothic manner, consisted of a large lecture room, ground floor research rooms and workshop, and class rooms above. In this building Maxwell, Rayleigh and J. J. Thomson built up the Cambridge school of experimental physics. Between the years 1877 and 1893, the number of students rose from 22 to 150, and in 1893 the first extension of the Laboratory was made, houses in Free School Lane being converted into a large class room for elementary teaching with a small lecture room and offices above. In 1896, with the admission of graduates of other universities to carry out research work with J. J. Thomson, the number of research workers gradually increased, and by 1906 further extensions became necessary. For this Lord Rayleigh generously handed over the sum of £5,000, being the greater part of his Nobel Prize, and by 1908 the ground floor research rooms known as the 'Garage', the lecture room above and the small block of research rooms on the second floor had been completed.

During the directorship of Lord Rutherford, the number of research workers in the Laboratory increased further to between forty and fifty, and to provide for this and for the increasing scale of the work, further accommodation became urgently necessary. Fortunately for the development of the work, the great Rockefeller benefaction of 1930 enabled the University to provide new accommodation for the biological departments, and to hand over some of the old buildings adjoining the Cavendish Laboratory until such time as they could be reconstructed.

Plans were then prepared showing how the site could best be used, and the organisation of an appeal for the sum of £250,000 was commenced. Much interest has been shown by many friends of the Cavendish. They will be delighted to hear of this splendid gift by Sir Herbert Austin.

The University, in the confident expectation that the appeal would succeed, had already authorised the construction of a new high-voltage laboratory. It will now be possible to prepare a more far-reaching scheme including a new research block on the site of the old Zoological Laboratory, and some reorganisation of the teaching wing. It should also be possible to meet many long-felt needs of the Laboratory, and to provide substantially increased facilities for research.

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We have received the following appreciative notice of the work of the Cavendish Laboratory from Sir Ambrose Fleming:

IN common with all other Cambridge men, I am enormously gratified to hear of the splendid munificence of Sir Herbert Austin in giving a quarter of a million sterling to the University of Cambridge for the special benefit of the Cavendish Laboratory.

That Laboratory and chair of physics was founded in 1870 by the generosity of the seventh Duke of Devonshire, then Chancellor of the University, and the first occupant of the chair was James Clerk Maxwell whose contributions to science had made him then of world-wide fame. Under him the Laboratory was designed and equipped. Among a small number of his first students I had the privilege of being numbered. This group included the late Principal W. M. Hicks, Sir Richard Glazebrook, Mr. J. E. H. Gordon, Prof. G. Chrystal, Sir Arthur Schuster and Prof. J. H. Poynting, with William Garnett as

demonstrator. My own work there consisted, at Maxwell's suggestion, in comparing the existing B.A. standards of resistance with the object of ascertaining the most probable value of the B.A. unit, the absolute value of which was afterwards determined by the work of Lord Rayleigh and Sir Arthur Schuster. For this purpose a special form of resistance balance was designed which was in use for many years afterwards at the Cavendish Laboratory.

After the lamented decease of Prof. Clerk Maxwell in 1879, Lord Rayleigh consented to hold the chair for a time in response to a universal request, and made in a few years most notable contributions to exact electrical measurement.

Then on Lord Rayleigh's retirement, Sir J. J. Thomson, now Master of Trinity College, was appointed, and began his epoch-making researches on the constitution of the atom. Under him a large number of research workers were gathered whose discoveries made the Cavendish Laboratory world-famous.

On Thomson's retirement, Lord Rutherford succeeded to the chair, and his great discoveries in radioactive matter and the structure of the atom have opened new chapters in the history of science. With him have been associated other workers whose researches have given them fame. The work of Dr. Aston on isotopes and the discovery of the neutron by Prof. James Chadwick, and more recent work by others, such as Drs. J. D. Cockcroft and E. T. S. Walton, have made departures of an importance not easily overstated.

This donation of Sir Herbert Austin will, I believe, be devoted to the erection and equipment of a new high-voltage laboratory, where electromotive forces of a million or more volts will be employed to hurl the hardest particles in nature, namely the alpha particle, at other atoms, and so break up their nuclei. It is possible by some such process that an artificial radium may be produced with all the valuable properties of the natural radium in therapeutic work. It is impossible yet to foresee all the supreme importance of the outcome of such a new laboratory. We know already that enormous stores of atomic energy are awaiting discovery and utilisation, and this great benefaction of Sir Herbert Austin when utilised by the resourceful and able research workers in physics at Cambridge will unquestionably bring in due course not only greater knowledge but also greater benefits to mankind.

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# Blackpool Meeting of the British Association

THE visits of the British Association to Lancashire have not been infrequent—they began with the Liverpool visit of 1837—and its members know, and appreciate, the traditions of Lancashire hospitality. In its history of a hundred and five years the Association has visited Liverpool six times, Manchester thrice and Southport twice. Now the Association will enlarge its experiences, having accepted for this year (September 9–16) the invitation extended by the Mayor and Corporation of the Borough of Blackpool.

Each of the great cities of the North has its special characteristics, but their civic and industrial activities may be matched in other regions. Blackpool may fairly be said to be unique. It has devoted itself to the problems of the systematisation of mass-amusements with a spaciousness which is all its own. In these, and in its municipal activities, it has preserved a pioneering energy and ability to take the long view given to it by the far-sightedness of its first Mayor, the late Dr. W. H. Cocker—an ability which has made Blackpool's remarkable experiments in town lighting and traction models for other communities for more than fifty years past. The Blackpool meeting also affords special opportunities for the study of what is, in its integrity, a little-known corner of the kingdom. The Fylde is a division of England the natural features of which will well repay investigation, a division which still has its own peculiarities of thought and diction and the villages of which preserve something of the atmosphere of those days when the Industrial Revolution was not.

Sir Josiah Stamp will deliver his presidential address in the Empress Hall of the Winter Gardens. The exact title of the address is not announced, but it will deal with the impact of science on society—a subject at once arresting and topical. The spirit of the age is less and less in sympathy with the view that science may be pursued regardless of its repercussions on the community; nor, in these times, may we be quite so complacent concerning the benefits conferred by science on society as was the fashion in the days of Samuel Smiles. Eugenic and dysgenic effects must be considered, and those who look to Sir Josiah Stamp for an analysis of these repercussions which shall be critical, far-reaching and provocative, are not likely to be disappointed.

The sectional presidential addresses cover a wide field, and in many instances deal directly with the bearing of scientific investigation on the

life of the community. The list of the addresses is as follows:

Section A (Mathematical and Physical Sciences): Prof. Allan Ferguson, "Trends in Modern Physics"*; Section B (Chemistry): Prof. J. C. Philip, "The Training of the Chemist for the Service of the Community"*; Section C (Geology): Prof. H. L. Hawkins, "Palæontology and Humanity"; Section D (Zoology): Dr. Julian Huxley, "Natural Selection and Evolutionary Progress"; Section E (Geography): Brigadier H. S. L. Winterbotham, "Mapping of the Colonial Empire"*; Section F (Economic Science and Statistics): Dr. C. R. Fay, "Some Aspects of Commercial Agriculture"; Section G (Engineering): Prof. W. Cramp, "The Engineer and the Nation"*; Section H (Anthropology): Miss D. A. E. Garrod, "The Upper Palæolithic in the Light of Recent Discovery"; Section I (Physiology): Prof. R. J. S. McDowall, "Integration of the Circulation"; Section J (Psychology): Mr. A. W. Wolters, "Patterns of Experience"; Section K (Botany): Mr. J. Ramsbottom, "The Uses of Fungi"*; Section L (Education): Sir R. Livingstone, "The Future in Education"; Section M (Agriculture): Prof. J. Hendrick, "Soil Science in the Twentieth Century"*.

The Council of the Association has evidently been studying its statutes, and has wisely interpreted the phrase, "to obtain more general attention for the objects of Science and the removal of any disadvantages of a public kind which impede its progress", as one of encouragement to the Council in its response to the growing public demand for a discussion of the more immediate bearing of advances in science on the life and well-being of the community. With the exception of the mathematical theorem which its discoverer announced as—"Thank Heaven, of no possible use to anyone, at any time, or in any circumstances", there are no advances in science which may not, potentially, influence the life of the community; but some discoveries are more remote in their influence than others. Moreover, titles are misleading; and the new policy of indicating by an asterisk those subjects of more immediate public interest is one which should commend itself alike to the members of the Association and to the Press.

The programmes of the sections, even in their present brief form, illustrate in a very interesting fashion the tendency to move from isolated papers to discussions. Discussions, either within a section, or jointly between two sections, are likely to bulk largely in the Blackpool programme; and of these discussions quite a large fraction is concerned with topics of community interest. Thus, discussions on high voltages and on textiles, on chemistry and the community, on scientific problems of the poultry industry, on Abyssinia, on economic problems affecting Lancashire, on engineering problems of mass-amusement, on climate and health, on botany and gardening, on the social and cultural value of science, on the strain of modern civilisation, and on national nutrition and British agriculture, are examples, taken from the sectional programmes, of topics which have been starred as of immediate communal interest. And there is no lack of variety in the unstarred subjects for discussion. Genetics and the race concept, education for rural life, motor-car headlights, sea defences, the teaching of economics in schools, the agricultural geography of the Fylde, earth movements in north-east England, and the physical basis of living matter—these are but a selection from topics of general and of local interest.

The discussion, staged by Section A, on the evolution of the solar system, brings back memories of that wider discussion on the evolution of the universe which was such a prominent feature of the London meeting of 1931. It is specially appropriate that this related, if rather more modest, topic should come to the front at the Blackpool meeting. For Sir Oliver Lodge, the doyen of the Association, whose memories of its meetings reach back to those remote days when John Tyndall's Belfast address raised such a storm, has, after two years' absence, announced his attention to attend the Blackpool meeting. It was at the London discussion that Sir Oliver made his latest formal contribution to the proceedings of Section A. Is it too much to hope that the Section will again have the privilege of hearing its old friend and whilom president on one of the many topics which have engaged his interest?

The evening discourses will be delivered by Capt. F. Kingdon-Ward, who will speak on plant-hunting and exploration in Tibet, and by Mr. C. C. Paterson, who will deal with a subject of special interest to Blackpool—science and electric lighting.

A couple of generations ago, the Association was wont to arrange at its meetings popular addresses which were known as "Lectures to the Operative Classes". We have left such titles far behind today, but the practice survives, and public lectures of a popular type will be given during the week of the meeting in many of the neighbouring towns.

A number of most interesting sectional and general excursions have been arranged which should afford to members ample opportunity for making acquaintance with the beauty-spots and antiquities of Lancashire. The Lakes are well known, and an outstanding feature of the week will be a whole-day excursion to the Lakes on Saturday, September 12. A shorter Saturday

excursion may be arranged which will give an opportunity to explore the Ribble valley and to see something of the work which has recently been carried out at Whalley Abbey. Sectional excursions and visits will include the Metropolitan-Vickers Works at Manchester, Stonyhurst and Rossall, the freshwater biological station at Wray Castle, and the laboratories of Imperial Chemical Industries Ltd. at Blackley.

A four-days' excursion in the Furness district is being arranged in collaboration with the Yorkshire Geological Society immediately preceding the meeting, and a four-days' excursion to the Isle of Man after the meeting is under consideration.

The Mayor and Mayoress of Blackpool (Alderman Walter Newman, J.P., and Miss Newman) will hold a reception in the Winter Gardens on Thursday evening, September 10.

# Scenic Geography at the Royal Academy

"WHAT will this year's Academy teach us about the scenery of the world ?" was the question uppermost in my mind as I entered Burlington House. It was with particular satisfaction that I noted several instructive studies of the scenery of cities. The sky-line of the city is bolder than any which Nature can produce, but in the strong light of day the scene is generally confusing in its multiplicity of form, and in colour often drab and dull. But Mr. C. R. W. Nevinson's two studies of London in twilight illustrate the advantages of civic scenery without its drawbacks. "Hail and Fairwell" (730) gives us a last view of the round arches of Waterloo Bridge with the harmonious curves of the dome of St. Paul's in the background, with the grey of twilight changed to a deep and tender shade of blue by the amber glow of the street lighting. In his second study, "Battersea Twilight" (727), the sky-line beyond a foreground of the Embankment and river is dominated not by a Cathedral but an industrial building, the Battersea Power House with its two great chimneys. There is a story that Whistler replied to a friend who complained of the prominence of factory chimneys, "Call them campaniles". It is to be hoped that in a future exhibition Mr. Nevinson's study may be followed by one taken from a nearer stand-point where the details of Sir Giles Gilbert Scott's design can be seen, particularly the fluting of the chimneys which so greatly enhances the columnar effect. This is the artistic touch that campaniles share but which the older factory chimneys lack. It is a hopeful sign of the times that the architect of Liverpool Cathedral has been entrusted with the design of this great industrial building. If the practice becomes general of obtaining the best architectural advice for factory building, the social benefit will be great, for if these huge erections were made beautiful the community would realise better the romance of industrial achievement.

Among the studies of purely natural scenery none has more poetic appeal than Mr. Julius Olsson's large painting of "Land's End and Longships Light" (151). Below the dark cliff a broad band of foaming surf is lit by the moon, which shines through a rift in the sombre clouds. Two studies of the Cornish coast (246 and 541), by Mr. Charles Simpson, remind us of the importance of taking steps to preserve this wild shore as a sanctuary of scenery. Mr. Borlase Smart's "Along our North-West Coast" (540) is one of the few studies of the shore viewed from the sea, which when the land is mountainous is one of the most attractive aspects of natural scenery. The recent extension of the programme of pleasure cruises, now much better organised than heretofore, would provide the sea painter with a travelling studio for such studies. Thus, passing west of Teneriffe on the outward and to the east on the homeward voyage of the *Almanzora*, I recently saw the whole circumference of the wonderful Peak from an advantageous distance with exquisite effects of cloud and sky.

Of mountain scenery there is a fine example in Mr. Harry Van der Weyden's "From the Path to Castellar" (121), in which the nobility of height is associated with the solemnity of shadowed valleys where the sun's declining rays can no longer penetrate.

The quiet charm of the fields, woods and rural architecture of the English countryside is the welcome theme of many works. Mr. Oliver Hall's "Leckhampton Court from the Lawn" (22) possesses in full measure the restful dignity characteristic of this artist's work. Mr. Alfred J. Munnings's "A Farm in Suffolk" (60) illustrates the advantageous setting which the small undulations of the Suffolk landscape provide for the picturesque old farm houses. The suave lines of the rolling chalk downs are the subject of pleasant watercolours by the Very Rev. W. Foxley Norris, "Chanctonbury Ring" (777) and by Mr. Charles H. Larkin, "The Downs, Poynings, Sussex" (956).

In Mr. Karl Hagedorn's "Spanish Fishing Boats" (702) we have a study of the captivating curves of sailing craft which it is now so urgent to record.

Sir John Lavery's impressive portrait "Grey Owl" (553) is of special interest to the scientific world. This man, a Red Indian, by a self-denying life in the company of beavers, has carried our knowledge of an animal species to a point which it is only possible to attain when intellect is reinforced by loving-kindness.

VAUGHAN CORNISH.

Among the portraits of men of science are Catherine Dodgson's chalk drawing, "Sir Thomas Barlow, Bt., M.D., F.R.S." (1236); a white metal bust "Dr. Alexander Scott, F.R.S." (1518) by Sir W. Reynolds-Stephens; a charcoal drawing of Sir Almroth Wright, K.B.E., C.B., M.D., F.R.S. (1212) by Francis Dodd and also a bronze bust of Sir Almroth (1503) by Donald Gilbert; oil paintings of "Dr. J. Vargas Eyre, Ph.D., M.A." (375) by Algernon Talmage, and "A. E. Morgan, Esq., M.A., Principal and Vice-Chancellor of McGill University, Montreal, formerly Principal of University College, Hull" (409) by Frederick W. Elwell; miniatures of "Emeritus Professor R. W. Reid, M.D., LL.D., F.R.C.S.", emeritus regius professor of anatomy, University of Aberdeen (1055) by Isabella E. Reid, and "Bernard Dyer, Esq., D.Sc." (1133) by Inés Johnson; mezzotints of "Thomas Telford, after Sir Henry Raeburn, R.A." (1311) and "The Viscount Wakefield of Hythe, C.B.E." (1335) by H. Macbeth-Raeburn.

In addition, mention may be made of two architectural drawings by Charles Holden, "London University: Bird's-eye View from South-West" (1368) and "London University" (1451).

# Hofmann and his Influence on Chemistry in Great Britain

IN his Hofmann Memorial Lecture, delivered at the Imperial College of Science and Technology on May 4, Prof. G. T. Morgan dealt with A. W. von Hofmann's career as chemist and teacher, and vividly recalled the extraordinary influence which he had on contemporary chemistry and chemical technology in Great Britain.

The main facts of Hofmann's life and work are well known through the original lectures delivered before the Chemical Society in 1893 by Lord Playfair, Sir Frederick Abel, Sir William Perkin and Prof. H. E. Armstrong. Hofmann came to England from Bonn in 1845 as a young man of twenty-seven, and spent the best years of his life in this country. Most chemical discoveries had until that time been the work of brilliant individuals, and it was left for Hofmann and for Graham to found the first schools for the training of chemical investigators. The times were peculiarly propitious for the new developments: Liebig's tour of the country in 1842 had awakened a general interest in chemistry, and, under the leadership of the Prince Consort, Sir James Clerk and Playfair, the Royal School of Mines and Royal College of Chemistry were founded. Hofmann became the first director of the latter, which rapidly developed as a centre for both instruction and original research. The early account books of the College show that chemistry became a popular and even fashionable study, owing no doubt to Hofmann's close associations with the Royal family. When he left England, twenty years later, to use Prof. Morgan's words, "Hofmann had established a school of research in organic chemistry such as had never existed before in this country."

Organic chemistry was then beginning the rapid development which was one of the main features of the science of the second half of the nineteenth century, and Hofmann was one of the first great chemists to specialise in this particular branch. His name is particularly associated with that of aniline, the compound which he described as his first love. In 1843, he investigated the "cyanol" of coal tar and suggested that this was identical with the bases "aniline" and "crystallin" prepared by the degradation of indigo and with the "benzidam" obtained by reducing nitrobenzene, a view which was afterwards shown to be correct. In later investigations he dealt with a wide range of derivatives of aniline, including the chloranilines and the phenyl carbamides. The early experiments were greatly hampered by scarcity of material; aniline was made from indigo and "the production of a few ounces was a proud achievement".

Hofmann was greatly attracted by Wurtz's contemporary discovery of monomethylamine and monoethylamine. This led him to investigate whether the remaining two hydrogen atoms attached to nitrogen in aniline and the alkylamines could be substituted by alkyl radicals without affecting the general nature of the bases. This led to the discovery of the alkyl anilines and of the quaternary ammonium compounds. Hofmann at once correctly interpreted the nature of these substances and their theoretical significance. Prof.

Morgan pointed out that the work foreshadowed the discovery that the four radicals surrounding the nitrogen atom in the tetra-alkyl ammonium salts are in equivalent positions. Another example of Hofmann's acumen in theoretical matters was shown in his work with Cahours on the corresponding compounds derived from phosphorus, in which the analogies between nitrogen, phosphorus, arsenic and antimony were clearly recognised. This was some twelve years before the development of the periodic law by Mendeléeff and Lothar Meyer. For the preparation of the trialkyl phosphines, Hofmann and Cahours used the corresponding zinc alkyls, which had recently been discovered by Frankland. With these classical investigations, the name of Hofmann will always be associated.

Prof. Morgan's lecture recalled many less known facts, for example, that Hofmann was responsible for the discovery of allyl alcohol, the first unsaturated alcohol (with Cahours), and of formaldehyde.

A brilliant group of pupils and assistants worked under Hofmann's direction during the prosecution of these researches. They included Abel, de la Rue, Merck, Crookes, Divers, Clowes and Newlands and the founders of the synthetic dyestuff industry in Perkin, Nicholson, Mansfield, Griess, Martius, Medlock and Greville Williams. The record of these men in science and technology is a testimony to Hofmann's extraordinary power of kindling enthusiasm among those with whom he came into contact.

Hofmann was the midwife at the birth of the organic dyestuff and fine-chemical industry. His pupils founded the first factories, and his researches on the aromatic bases acted as the scientific foundation of the technical processes. Prof. Morgan gave a very interesting picture of the influence which Hofmann and his school had on the early growth of the industry. Perkin's original discovery of mauve was made at a time when he was Hofmann's assistant, and the connexion was maintained by Mansfield's collaboration with the firm of Read Holliday of Huddersfield, and with the scientific investigations of Hofmann himself and of Nicholson on the rosaniline bases. The name of Perkin is deservedly honoured. Nicholson and Mansfield have perhaps not received the recognition which their pioneer work merits.

It is well known that Perkin's second great success was the synthesis from anthracene of alizarine, the natural colouring matter of the madder root, used in the production of 'Turkey Red'. The first research assigned to Perkin by Hofmann was a study of "paranaphthalene", as anthracene was then called. The experience gained by Perkin, then sixteen years of age, must have been invaluable to him later.

Although the heroic period of the colour-making industry in Great Britain has passed, it is satisfactory to realise that it has completely recovered from its pre-War decline, and that, in Prof. Morgan's opinion, four of the six outstanding discoveries in tinctorial chemistry of recent times have been made by British chemists.

# Obituary

## Sir Archibald Garrod, K.C.M.G., F.R.S.

ARCHIBALD GARROD, who died at the age of seventy-eight years on March 28 last, was a physician to whom the chemical aspects of pathology and clinical medicine made a special appeal. His father, Sir Alfred Garrod, M.D., F.R.S., had the same tastes. He was deeply interested in chemistry as a science, and though professional calls left little leisure for these pursuits, delighted in laboratory experiments. As many will remember, Alfred Garrod was the first to give a convincing demonstration of the presence of uric acid in the blood of gouty patients. This was in 1848, and his son was able to claim with pride that it involved the first biochemical observation of the kind made on the living human body. These paternal interests may have awakened those of the son, though in the latter love of chemistry seems to have been innate.

Archibald Garrod went from Marlborough to Christ Church, Oxford, and took a first class in natural science in 1884. For his medical training he joined St. Bartholomew's Hospital and became distinguished as a student. He was marked out for the visiting staff, but promotion at Bart's. was at that time very slow, and it was not until 1903 that he became assistant physician. In the intervening years, however, he held other clinical posts, of which the most important was that of honorary physician to the Great Ormond Street Hospital for Sick Children. It was during these years that he found leisure for personal research.

Garrod was led to take a special interest in urinary pigments, and between 1892 and the end of the century he published a series of papers dealing with these. Each of the best known among the excretory pigments received his attention in turn; hæmatoporphyrin, urochrome, uroerythrin and urobilin. His publications on these were mainly descriptive, and the spectroscope played a chief part in the studies; but all the observations were

made with meticulous care, and the results very carefully recorded.

It was just before the end of the century that Garrod's interests turned to the subject of alkaptonuria. It was his contact with this anomaly which led him to think so deeply, and to write so brilliantly, concerning what he came to call "chemical malformations", or "inborn errors of metabolism". In 1899 he published an important paper on this anomaly in which the data recorded in all known cases were assembled, and which described two cases studied by himself. Emphasis was laid on the circumstance that the condition was not a disease but an individual variation from the normal; and, moreover, that its distribution is familial. It was later pointed out by Bateson and Punnett that its mode of incidence finds a ready explanation if it be regarded as a recessive character in the Mendelian sense.

This increased Garrod's interest in the subject. His own further studies of cystinuria, and the efforts he made to gather and study all the data from the literature bearing upon these and analogous conditions, such as albinism and pentosuria, led to the publication in 1909 of his book "Inborn Errors of Metabolism". A second edition appeared in 1923 in which new chapters dealt with instances of inborn metabolic defects unrecognised as such when the first edition was published. This book, so ably written and so full of interest, has stimulated the thought of many, and has to my knowledge led not a few students to seek a career in biochemistry. Its author's interest in the subject of the book never weakened. Among his later publications was one in which, conjointly with L. G. J. Mackey, he described a case of congenital hæmatoporphyrinuria, and another (with W. H. Hurtley) on congenital family steatorrhœa.

It is sure that had he chosen a career in science, Garrod would have taken high rank as an investigator. Professional calls, especially in later years, left him little leisure for personal research, but his interest in science and especially in the progress of biochemistry was abiding. During the seven years of his tenure of the regius chair of medicine at Oxford (1920–27) he held the needs of the scientific departments always in mind, and did much to promote their interests.

Garrod's instinctive scientific attitude of mind was inherited, and is, it would seem, familial. His father, given opportunities, would have been an experimentalist of high rank, and his eldest brother, Alfred Henry Garrod, unquestionably attained to that rank. At Cambridge, the latter was an investigator when still an undergraduate. It must have been rare indeed in the history of the Royal Society for a father and two of his sons to be received into its fellowship. The spirit of the investigator has again shown itself in the third generation, though in another field of research. Sir Archibald's daughter, Dr. Dorothy Garrod, has acquired a world-wide reputation as an archæologist of high accomplishment.

F. G. HOPKINS.

## Mrs. R. E. Mortimer Wheeler

WE regret to record the death of Mrs. Tessa Verney Wheeler, wife of Dr. R. E. Mortimer Wheeler, Keeper of the London Museum, which took place after an operation on April 15. Mrs. Wheeler, who herself was on the staff of the London Museum, was a fellow of the Society of Antiquaries of London, and a field archæologist of much experience and ability. She took an active part in the excavations on prehistoric and Roman sites in Wales and England, with which her husband has been associated.

At Verulamium and on the later excavation of Maiden Castle, Dorchester, where voluntary assistants, some of whom were in process of being trained, made skilled supervision and leadership essential, Mrs. Wheeler's work was of the greatest value, especially when, in the absence of Dr. Wheeler, she herself took charge of the excavations. She took her full share in the recording and conservation of the finds, as well as in working up the results for report and publication. Mrs. Wheeler was also extremely active and helpful in the promotion and organisation of the Institute of Archæology in the University of London. Her death will be, in a very real sense, a great loss to British Archæology.

A wide circle will welcome the proposal that there should be some permanent memorial of Mrs. Wheeler's life and archæological work. Those who were closely associated with her in the promotion of archæological studies will agree that such a memorial could take no more appropriate form than some integral part in the working organisation of the Institute of Archæology of the University of London, as is suggested by Sir Frederic Kenyon and his fellow signatories in a letter to *The Times* of May 2. They indicate as possibilities the dedication of a room in the Institute, the provision of a working archæological library or a fund for the assistance of students, according as response to the suggestion allows. In view of Mrs. Wheeler's activities in connexion with the Institute and her interest in the training of students in the field, any one of these would be fitting. Communications relating to the proposed memorial and contributions may be sent to the secretary of the Institute, Miss Kathleen Kenyon, Kirkstead, Godstone, Surrey.

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WE regret to announce the following deaths:

Mr. Harold Cox, a well-known economist and journalist, who served in 1919 on the Royal Commission on Decimal Currency, on May 1, aged seventy-six years.

Prof. A. C. Dixon, F.R.S., emeritus professor of mathematics in Queen's University, Belfast, on May 4, aged seventy years.

Mr. L. W. Hinxman, district geologist in H.M. Geological Survey (Scotland) from 1905 until 1919, on April 29, aged eighty-one years.

Prof. D. Morrison, professor of moral philosophy in the University of St. Andrews, who was associated with Prof. G. F. Stout in the editorship of *Mind*, on April 8, aged sixty-nine years.

# News and Views

## Royal Society: New Fellows

AT a meeting of the Royal Society of London on May 7, the following fellows were elected: Dr. A. C. Aitken, lecturer in mathematical statistics and actuarial mathematics, University of Edinburgh; Dr. J. D. Cockcroft, demonstrator in physics, University of Cambridge; Prof. H. J. Fleure, professor of geography and anthropology, University of Manchester; Mr. C. Forster-Cooper, director of the University Museum of Zoology and reader in zoology, University of Cambridge; Sir Alexander Gibb, consulting engineer; Mr. H. L. Guy, chief engineer, Mechanical Engineering Department, Metropolitan Vickers, Ltd.; Prof. H. G. A. Hickling, professor of geology, Armstrong College, Newcastle-on-Tyne; Prof. Lancelot Hogben, professor of social biology, University of London; Dr. J. Kenyon, head of the Chemistry Department, Battersea Polytechnic; Prof. E. H. Kettle, professor of pathology, University of London; Prof. N. F. Mott, professor of theoretical physics, University of Bristol; Dr. R. G. W. Norrish, lecturer in physical chemistry, University of Cambridge; Prof. H. H. Plaskett, Savilian professor of astronomy, University of Oxford; Mr. E. F. Relf, superintendent, Aerodynamics Department, National Physical Laboratory; Dr. F. J. W. Roughton, lecturer in physiology, University of Cambridge; Prof. Birbal Sahni, professor of botany, University of Lucknow; Prof. E. B. Verney, Shields reader in pharmacology, University of Cambridge.

## Transmutation of Matter

DR. J. D. COCKROFT gave the twenty-seventh Annual Kelvin Lecture to the Institution of Electrical Engineers on April 23. He chose as his subject the transmutation of matter by high energy particles and radiations. In 1919, Rutherford's discovery that the central nuclei of atoms could be penetrated and permanently changed by a bombardment of very high speed atomic projectiles, such as those given off by radioactive bodies, proved that the ordinary elements are not immutable. It took some years before the importance of his experimental results was fully recognised. He observed that nitrogen gas, penetrated by helium nuclei, ejected hydrogen nuclei. It has been shown since that boron, fluorine, sodium, magnesium, aluminium, phosphorus and sulphur can be similarly transmuted. In the case of nuclear transmutations, it seems that the loss of mass is precisely equal to the increase in the kinetic energy that has taken place. This gives a striking proof of the modern physical law that mass and energy are equivalent. In 1932, Chadwick discovered the neutron, a new type of atomic particle which has no electric charge. It does not therefore interact with other electrons and produces no ionisation when passing through a gas. It is of outstanding importance because of its power to produce transmutations. There is little hope that this process can be used on an engineering scale to convert mass into energy. So far, our laboratory experiments produce the converse result. Theory indicates that at temperatures equal to those of the interior of the sun or stars, it might be possible to convert the inexpensive simple elements to the more valuable heavier combinations, but practically, there is no method of producing the effects formerly attributed to the 'philosopher's stone'.

## The Hofmann Memorial Lecture

THIS lecture, in memory of A. W. von Hofmann, was delivered by Prof. G. T. Morgan, director of the Chemical Research Laboratory, Teddington, at the Imperial College of Science and Technology on May 4, Lord Rayleigh, chairman of the Governing Body of the College, presiding. Hofmann was the first director of the Royal College of Chemistry, which was founded in 1845. He held this position for twenty years. The College was eventually renamed the Royal College of Science, and became a constituent part of the Imperial College at South Kensington. In previous years, Huxley Memorial Lectures have been given at the College during the first week of May; in future, these will be alternated with lectures commemorating other distinguished men who have been associated with the Imperial College or its forerunners. The Hofmann Memorial Lecture was the first of the new series, and Prof. Morgan, from his early associations with the College and his work in organic chemistry, was an appropriate choice as lecturer. A brief account, giving the substance of the lecture, appears elsewhere in this issue (p. 769), and the complete lecture is also available (London: Macmillan and Co., Ltd., 1s. net).

## Native Lands in South Africa

IN recent discussion in the Union of South Africa relating to the Cape franchise and native representation in Parliament, it was generally understood that, when once this question had been settled, consideration would be given to the problem of native lands, in accordance with an undertaking outstanding for many years. At present the lands held as native reserves comprise some 20,000,000 acres, which in part owing to native custom, in part owing to increase in population, is admittedly quite insufficient for tribal needs. In order to remedy a situation which is the cause of considerable unrest, and as General Hertzog, the Prime Minister, stated in Parliament, as an earnest of the Government's sincerity in dealing sympathetically with native needs, a Bill has been introduced, of which the second reading was moved by Mr. Grobler, Minister for Native Affairs, on April 30. Under its provisions, a South African Native Trust is to be established, which will be administered by the Governor General. In this Trust will be vested all la

native occupation; and further land is to be purchased out of moneys to be provided by Parliament. Purchase will be spread over a period of five years, the total amount of the expenditure being £10,000,000. This will admit, it is expected, of an addition of 14,000,000 acres to the reserves. Among the provisions of the Bill it is proposed to include the gradual abolition of native squatting on European-owned lands and the registration of native labour tenants. Of these the former will in all probability arouse some opposition on the part of various interests; but the practice has given rise to friction and abuse on occasion, and on the whole its abolition is probably well advised.

### Control of Australian Aborigines

AN innovation of no little importance in the method of controlling the Australian aborigines, who come under the jurisdiction of the Commonwealth Government, is announced from Canberra. The Cabinet has decided, it is reported by *The Times* correspondent in the issue of April 29, that in future the work of the police patrol in the south-west of the Northern Territory will be entrusted to an anthropologist who is familiar with the language and customs of the tribes. The district under the new officer will thus include the country of the Arunta, made famous in the annals of anthropology by the investigations of Sir Baldwin Spencer and F. J. Gillen. This change in administrative machinery is, no doubt, in large measure due to the protests made, especially by anthropologists, when recently certain aborigines were tried for murder on account of killings in accordance with tribal custom. It is, at any rate, regarded as marking an advance in the method of dealing with native offences against the law of the white man, as the officer will have magisterial powers to deal with the great majority of cases, and will take only the more important to the court at Alice Springs. Mr. Paterson, the Minister for the Interior, has announced that Dr. Strehlow of the University of Adelaide, now conducting investigations on behalf of that University in North Australia, has been appointed to the post.

### Scientific Research in Australia and New Zealand

AT the instance of the Governments of Australia and New Zealand, steps are being taken to effect close collaboration between their respective Councils for Scientific and Industrial Research. The two Dominions have in common many problems in primary industry, and united action to solve them is obviously desirable. It is proposed to attach New Zealand officers to the Australian teams working on (*a*) mammitis in dairy cattle, (*b*) bovine contagious abortion, (*c*) sterility in sheep and (*d*) preservation and transport of foodstuffs. Australia will probably second an officer to the staff of the Dairy Research Institute of New Zealand, and will send the leaders of its Soils and Forest Products Divisions to consult with their corresponding numbers there about future co-operative organisation. This move for closer association between the research councils of the Dominions is overdue and its development will be watched with much interest.

### The Parliamentary Science Committee

DURING the past twelve months several institutions have affiliated with the Parliamentary Science Committee; and the approximate aggregate membership of all the bodies affiliated is now 100,000. Two of the latest bodies to enrol themselves are the Institution of Gas Engineers and the British Association of Zoologists. The last-named accession affords peculiar satisfaction to the Committee, inasmuch as it is the first enrolment of a body devoted to pure—as distinct from applied—science; and it is hoped that it is the harbinger of others to come. Many societies devoted to natural history were perturbed last year at the prospect of a bombing centre being established near Chesil Beach. Letters of protest were published in the daily Press, but more effective action might have been taken by bringing the matter before Parliament through such a medium as the Parliamentary Science Committee, which actually meets at the House of Commons. By so doing, naturalists would have had the advantage of common action on their behalf by a Committee entitled to speak for an aggregate of 100,000 people interested in scientific matters—a body not to be lightly disregarded by a House of Commons the individual members of which owe their presence in that assembly to the votes cast in their favour.

### Physics of the Divining Rod

THE April number of *Discovery* contains an article on the divining rod by E. Christie which gives a detailed account of methods adopted by the author in searching for water and certain metals. It claims to show that there is nothing mysterious about the power of divining, and that it is subject to definite natural laws. The great difficulty which impedes the progress of scientific investigation is that the statements of dowsers regarding their methods in the field and manner of inference vary considerably, and the article mentioned only adds yet another to the many already published. That there is a basic similarity cannot be denied by anyone who has taken the trouble to study them, but the elucidation of the fundamental facts from what are necessarily very subjective accounts has so far not been achieved. The author, however, is right in stressing the point that without examining the details, in such accounts as he has written, no man of science is likely to arrange a reliable test for dowsers. Experiments in which the underlying physical process is unknown are always difficult to interpret, and it is very doubtful whether a conclusive proof of the claims of dowsers will be obtained unless much more attention is given to their writings, vitiated as they nearly always are, by the incorrect use of the terminology of physics.

### Royal Institution: Annual Meeting

THE annual meeting of the members of the Royal Institution was held on Friday, May 1. In the unavoidable absence of the president, Lord Eustace Percy, the chair was taken by the treasurer, Sir Robert Robertson. The Committee of Visitors, in a preface to its annual report, which was presented at

the meeting, referred to the loss the Institution had sustained by the lamented death of its patron, His Majesty King George V. At a recent general monthly meeting it was announced that His Majesty King Edward VIII had been graciously pleased to grant his patronage to the Institution. The Visitors' Report referred to the increased attendance at the lectures of late. The recent course of Christmas Juvenile Lectures, given by Dr. Kenneth Mees on Photography, had an average audience of 515, and a Friday Evening Discourse given by Sir James Jeans on November 29 had an attendance of 640, the largest at the Institution for many years. The Dewar research fellowship, set up under the will of the late Lady Dewar, has been filled by the appointment of Mr. A. R. Ubbelohde, lately senior scholar of Christ Church, Oxford, as the first Dewar fellow. Mr. Ubbelohde has begun investigations on the changes in the palladium lattice caused by the presence of hydrogen, as measured by X-rays, and on the latent heat of sublimation of chain compounds.

PART of the Brown legacy of between £25,000 and £30,000 has been invested by the Managers of the Royal Institution in the purchase of the freehold of No. 19, Albemarle Street, immediately adjoining the premises of the Institution. The purchase has been made in anticipation of future expansion of the research and other activities; but for the present, only the top two floors of the house have been occupied for Institution purposes. The remainder is being let on lease. The reconstruction of the principal library and the rooms below, which the Managers were compelled to undertake last year, is still in progress; and is expected to be completed during the summer. The large new research laboratory in the basement, the construction of which has been made possible by these alterations, promises to be a most valuable improvement. During the year, the publication by the Institution of "Faraday's Diary" has been completed by the issue of vol. 7 and a separate index volume. The Treasurer's report and accounts show a sound and satisfactory position, with substantial additions to the funds during the year despite the heavy cost of the library reconstruction scheme. This reconstruction has caused an interruption in the research work in progress with the large 50 kva. X-ray generator; but in other researches there has been considerable progress, as the report of the Committee of the Davy Faraday Research Laboratory shows. X-ray structure determinations, related chemical and magnetic problems, the optical study of methane, the construction of a hydrogen liquefier and the ether drift experiment are some of the experimental investigations referred to in the report. The following officers were elected for the year 1936–37: *President*, Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips.

### Salaries in the Civil Service

AT the annual general meeting of the Institution of Professional Civil Servants held on April 30, the president, Sir Richard Redmayne, referred to the inadequacy of the remuneration of the highest posts in the specialist departments of the Civil Service. He directed attention to the recommendations made by the Royal Commission in 1931 that a salary of £2,500 should be paid to the Engineer-in-Chief in the Post Office, and that there should be "a certain number of posts carrying an inclusive salary of £2,000 a year", and to the fact that these recommendations have not yet been carried into effect. He also pointed out that the Committee on the Staffs of Government Scientific Establishments in 1930 commented on the inadequacy of the prospects offered for the higher posts in the scientific establishments, and recommended that a small *ad hoc* committee should be appointed to consider these posts. In spite of this recommendation no action has been taken. Sir Richard claimed that the placing of the directing posts in the professional, scientific and technical departments on some degree of equality of status and remuneration with those obtaining on the non-technical side of the Service would conduce to that greater efficiency of the Service, which it is the primary aim of the Institution to promote. Sir Richard referred to the recent vote in the House of Commons on the question of equal pay for equal work as between men and women. He stated that the Institution is an unqualified supporter of the principle of equality.

### Rockefeller Foundation and International Health

THE annual report for 1934 of the International Health Division of the Rockefeller Foundation, recently issued, gives an account of the world-wide activities of the Foundation in the field of public health. The projects in operation for which grants are made are broadly speaking of three types: (1) the control of specific diseases, (2) aid to Governments to establish public health on a permanent basis, and (3) public health education. Under the first-named, investigations upon the control of yellow fever have resulted in the discovery in South America of a type of rural or jungle yellow fever, which differs from the usual form in that it is not conveyed by the yellow fever mosquito, which is completely absent in such districts. How this form of yellow fever is conveyed to man is at present unknown. Malaria, hookworm disease, yaws, diphtheria and tuberculosis are some of the other diseases that are the subject of investigation. Foundation aid has been granted to the Bureau of Hygiene and Tropical Diseases of the British Colonial Office, to the Irish Free State and to the United Provinces, India, for local health services, and to the Calcutta school of public health. The total expenditure for the year amounted to 2,433,535 dollars. The volume is illustrated with a number of interesting plates.

### Recent Acquisitions at the Geological Survey and Museum

THE gemstone collections of the Geological Survey and Museum have been recently enriched by a number of valuable presentations by H.M. Queen Mary. These include a large polished and carved block of yellow amber weighing 26 ounces, probably from the Prussian coast of the Baltic Sea; an exceptionally

large nodule of pyrope garnet from the Premier diamond mine of South Africa, and a fine rounded water-worn crystal of parti-coloured tourmaline, sectioned to show the colour. The Museum has acquired a large water-worn crystal of topaz of gem-stone quality, about eight inches in diameter, with a cleavage plate of the same mineral, from Brazil. The weight of the larger specimen is 29¼ lb. Other important acquisitions include the late Dr. H. Bolton's valuable collection of Carboniferous insect wings, presented recently to the Department of Palæontology.

### Thunder Census Organisation

THE survey of thunderstorms in the British Isles during the coming summer is to be continued and again the co-operation of readers of NATURE in the observational work is requested. Fuller details can be obtained from Mr. S. Morris Bower, Langley Terrace, Oakes, Huddersfield. The census has recently been extended into the winter months in order to bring the winter data, collected between 1925 and 1929, more nearly up to the standard of the summer survey, and also to make special reports on individual storms available for insurance and other purposes throughout the year. The lightning damage survey has been commenced in some parts of the country, and it is intended to build up this work gradually: sections of maps, on the scale of two miles to the inch, are issued to observers, who are invited to record local positions of damage.

### Awards for Aeronautical Research

AT a meeting of the Council of the Royal Aeronautical Society held on April 21, the following awards were made: *Silver Medal of the Society* to Mr. B. N. Wallis, for his work on geodetic construction; *Simms Gold Medal* to Mr. W. S. Farren, for his inventions of new methods of the measurement of drag and his designs of scientific apparatus for aeronautical research; *Taylor Gold Medal* to Mr. E. F. Relf, for his paper read before the Society on the compressed air tunnel; *Sir Charles Wakefield Gold Medal* to Mr. C. R. Fairey, for his work on the development of flaps; *Busk Memorial Prize* to Mr. R. P. Alston, for his paper read before the Society on wing flaps and other devices as aids to landing. At a meeting of the Amulree Committee held on April 27, the following awards were made on the recommendation of the Council of the Royal Aeronautical Society: *British Gold Medal for Aeronautics* to Dr. Hugo Eckener for his technical achievements in lighter-than-air craft; *British Silver Medal for Aeronautics* to Mr. A. J. Rowledge, for his scientific achievements in the development of aircraft engines.

### Announcements

THE Council of the Royal Society of Edinburgh has awarded the Keith Prize for the period 1933–35 to Prof. Lancelot T. Hogben, for his papers on genetical subjects published alone and in collaboration, which have appeared in the *Proceedings* of the Society during the period of the award; and the Neill Prize for the period 1933–35 to Dr. Samuel Williams, University of Glasgow, for his contributions to the anatomy and experimental morphology of the Pteridophyta.

DR. W. E. HARPER, of the Dominion Astrophysical Observatory, Victoria, B.C., who has been assistant director since 1923, has been appointed director in succession to Dr. J. S. Plaskett, who retired last year. Dr. J. A. Pearce, astronomer at the Observatory since 1924, has been made assistant director.

IN 1935 the directors of Teyler's Foundation and the members of Teyler's Second Society at Haarlem, Netherlands, announced a competition for a gold medal to be awarded for the best treatise on the interaction between atomic nuclei and electrons. Four essays were submitted, two from the United States and two from the Netherlands. The medal has now been awarded to Dr. H. B. G. Casimir, of Leyden. The prize essay will be published shortly in the *Transactions of Teyler's Second Society* and in the *Archives du Musée Teyler*.

THE twelfth Annual Norman Lockyer Lecture of the British Science Guild will be given by the Right Hon. Lord Rutherford on November 12. The lecture will be held in the Goldsmiths' Hall, Foster Lane, E.C.2 (by courtesy of the Goldsmiths' Company).

THE forty-seventh Annual Conference of the Museums Association will be held at Leeds on July 6–10, under the presidency of Sir Eric Maclagan. Further information can be obtained from Mr. E. W. Wignall, Chaucer House, Malet Place, London, W.C.1.

THE Medical Research Council will consider applications submitted by June 1 for a number of travelling fellowships in medical science (including clinical medicine and surgery) tenable abroad during the ensuing academic year. These will be awarded either by the Council or by other bodies on the Council's nomination, and will each be of the value of £400, with an additional allowance for travelling and special expenses. Applications will at the same time be received for other travelling fellowships restricted respectively to tuberculosis and to psychiatry or neurology. Further information can be obtained from the Secretary of the Medical Research Council, 38 Old Queen Street, Westminster, London, S.W.1.

SIR FREDERICK BANTING, Mr. Havelock Ellis and Dr. Robert Leiper were elected fellows of the Royal College of Physicians of London on April 30 by By-law XXXVIII (*b*).

PROF. SIGMUND FREUD, extraordinary professor of nervous pathology in the University of Vienna and well-known for his work on psychopathology and psychoanalysis, celebrated his eightieth birthday on May 6.

PROF. HUGO SPATZ, professor of psychiatry in the University of Munich and senior physician to the Psychiatric Clinic, has been nominated to succeed Prof. Oskar Vogt as director of the Kaiser Wilhelm Institut für Gehirnsforschung at Berlin-Buch.

A DISCUSSION on "The Present Status of the Theory of Natural Selection" will be held at the Royal Society on May 14 at 4.30. It will be opened by Prof. D. M. S. Watson.

THE annual Canadian Chemical Convention will be held at the Brock Hotel, Niagara Falls, Ontario, on June 9–11. British chemists who are likely to be in Canada at that time are advised to communicate with Dr. R. T. Elworthy, secretary of the Canadian Institute of Chemistry, 366 Adelaide Street West, Toronto, 2, Canada.

THE general meeting of the International Association for the Prevention of Blindness and of the International Organisation of the Campaign against Trachoma will be held at the Centre Marcelin Berthelot, 28 bis rue Saint-Dominique, Paris, on May 11 under the presidency of Prof. F. de Lapersonne. Further information can be obtained from the General Secretary, 66 Boulevard Saint-Michel.

AT the anniversary meeting of the Royal Society of South Africa held on March 18, the following officers were elected for 1936: *President*, Prof. L. Crawford; *Hon. Treasurer*, Prof. A. Brown; *Hon. General Secretary*, A. J. H. Goodwin; *Hon. Editor of Transactions*, Prof. R. S. Adamson; *Hon. Librarian* Prof. E. Newbery; *Council*, K. H. Barnard, H. G. Fourcade, J. Jackson, R. F. Lawrence, Dr. E. P. Phillips, Dr. A. W. Rogers, Dr. B. F. J. Schonland, Prof. R. B. Young.

THE March issue of *Film Progress* forms a Supplementary Bulletin to the "National Encyclopædia of Educational Films" (see NATURE, Dec. 28, 1935, p. 1007). It gives an account of the advance that has been made in the use of educational films in 1935, and brings the Encyclopædia of films up to date.

IT was stated in NATURE of May 2, p. 737, that the Royal Society possessed no bust of Faraday prior to Sir Robert Hadfield's recent gift. We are informed that this is incorrect. Dr. H. Bence Jones, F.R.S., presented to the Royal Society in 1873 a marble bust of Faraday by the sculptor, M. Noble; and in 1885 the Royal Society acquired a plaster bust which had been made by J. H. Foley, R.A.

IN reviewing Bodenheimer's "Animal Life in Palestine" in NATURE of January 4, p. 5, Prof. P. A. Buxton referred to the name 'scheltopusik'. Dr. B. N. Schwanwitsch, Entomological Laboratory, University of Leningrad, states that this is a native Russian name for the glass-snake (*Ophisaurus apus* Pall.), meaning literally 'yellow-bellied', which has been used in French and German zoological literature. This is, of course, no reason for its use in a work published in English, in which the reviewer also recognised German and Arabic names.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in engineering or mining technology in the Clowne Mining and Technical Institute, Clowne, Chesterfield—The Clerk to the Governors (May 16).

A head of the Engineering Department and a head of the Domestic Science and Women's Department in the Stockton-on-Tees Technical School Evening Institute—The Director of Education, Shire Hall, Durham (May 16).

A lecturer in pharmacy in the Witwatersrand Technical College, Johannesburg—Messrs. Frank Ross and Co., 9 Fenchurch Avenue, London, E.C.3 (May 16).

A lecturer in pathology and bacteriology in the Veterinary College, Madras—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 16).

A head of the Engineering Department of the Cheltenham Technical College—The Secretary (May 16).

An assistant lecturer in zoology and chemistry in the City Technical College, Liverpool—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool, 1 (May 19).

A demonstrator in physiology in the London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, W.C.1—The Secretary (May 20).

A lecturer in bacteriology in the University of Liverpool—The Registrar (May 22).

A lecturer in physiology and a lecturer in zoology in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (May 22).

An assistant in the Royal Observatory, Greenwich—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote C.E. 6235/35) (May 23).

A lecturer in engineering in the Leicester College of Technology—The Registrar (May 23).

A professor of mining and head of the Department of Mining and Fuels in University College, Nottingham—The Registrar (May 25).

A civilian education officer (Grade III) in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (May 25).

A lecturer in mathematics at the Goldsmiths' College, New Cross, S.E.14—The Warden (May 25).

A temporary information officer in the library of the Research Association of British Flour-Millers—The Director of Research, Old London Road, St. Albans.

An assistant engineer (civil) in the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4163).

Resident engineers for the construction of new aerodromes by the Air Ministry—The Secretary (W.B. 9), Air Ministry, Adastral House, Kingsway, London, W.C.2.

Structural engineering assistants in the Designs Branch of the Directorate of Fortifications and Works—The Under-Secretary of State (C. 5), The War Office, London, S.W.1.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 784.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Cause of 'Oil Patches' on Water Surfaces

WHEN water moving in a channel at constant velocity encounters an obstacle, say, a weir, retarding its motion, a stationary wave is formed called Bidone's wave after its first observer. The more gradual the change in velocity, the less conspicuous becomes the wave. I have found no reference in literature to the fact that at very low velocities the gravity wave is reduced to a capillary wave appearing like a very fine thread or hair floating on the surface. The phenomenon is strikingly revealed as a moving reflection or refraction image when bright sunshine falls on to the bottom of the channel (see Fig. 1, taken in 1932, at a point where a brook discharges into the Lake of Lunz, Lower Austria).

Minute floating particles crossing the thread are abruptly retarded and thus accumulate. With larger particles the effect is less conspicuous, indicating that only a very thin surface-layer (say, 1 mm. or less) is involved, at least close to the 'thread' on its downstream side, where coloured water if gently poured over the surface tends to remain. That capillary forces are largely responsible for the phenomenon is proved by pouring a liquid of lower surface tension like liquid paraffin over the surface, when the thread is at once displaced upstream by several metres.

The same phenomenon is observed along the leeward shore of a lake when a gentle wind is blowing (Fig. 2). Here the boundary (indicating a line of convergence) is formed 10–30 metres from the shore where the wind-driven surface-water dives below a thin layer of slowly moving water. Generally the thread itself is easily observed. Scattering aluminium powder over the surface brings out the circulation still more clearly. Where the convergence is bilateral, as is generally the case farther off from the shore, the 'oil patch' will assume the form of an oblong streak limited on each side by a 'thread'.

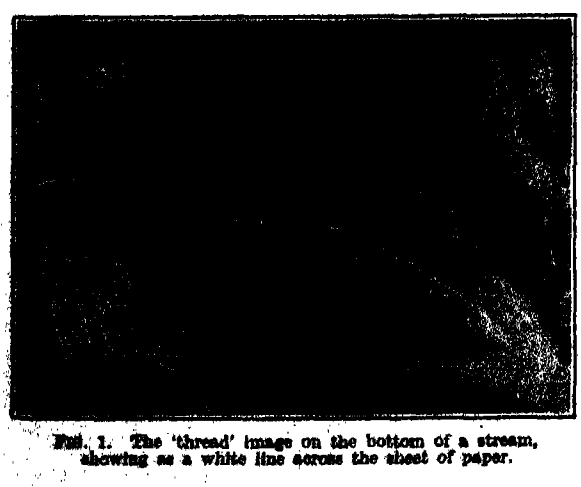


FIG. 1. The 'thread' image on the bottom of a stream, showing as a white line across the sheet of paper.

FIG. 2. 'Oil patches' on the Oberalp Lake, Switzerland, 1935.

These regions of retarded motion in a well-defined surface layer have mechanical effects analogous to those of real oil patches, that is, they have a damping effect on waves, especially those of short wave-lengths, smoothing out their crests. When viewed obliquely, the surface is apparently quieter inside than outside the boundary, an effect which is most marked when capillary waves are generated by raindrops. It is, however, also quite distinct with the wavelets due to a rising wind. With stronger winds and increased eddies the thread becomes less continuous, but is still visible from time to time. The layer itself is not broken up very easily, the 'oil patch' and its effect on waves remaining visible.

This explanation seems to agree well with other observations on 'oil patches', which are known to contain more pollution, surface plankton and sometimes fatty substances than the rest of the water, obviously a *consequence* of the formation of the layer and not its *cause*.

'Oil patches' in the form of long streaks left behind a boat crossing the lake persist as long as there is any descending motion in the surface. I have never found the position of similar streaks incompatible with the explanation here advanced. They seem to afford important clues to the general circulation in the water. A detailed study may help to explain various surface phenomena, like the great differences in velocity often manifest between the surface itself and the water some centimetres below.

The conditions of the formation of these 'threads' and their associated phenomena will be a subject of further study.

WILH. SCHMIDT.

Zentralanstalt für Meteorologie
und Geodynamik,
Wien.

March 19.

## The *Gegenschein* Observed at Sea

ON March 14, during a cruise on board R.M.S. *Almanzora*, I saw the Zodiacal Light strongly in the west when off the coast of Portugal in lat. 32° 30′ N. The season being favourable, I hoped to see the *Gegenschein*, or counterglow, which I had never observed. Realising the importance of unbiased vision in localising a faint luminosity, I was careful not to ascertain beforehand the distance of the sun below the horizon. Thus I did not know whether the sun's antipode was in Virgo or in Leo. I was also unaware which stars in these constellations lay upon the line of the ecliptic.

Looking eastwards, I saw a conspicuous band of light resembling the Milky Way which traversed Virgo and Leo and extended as far as the Praesepe

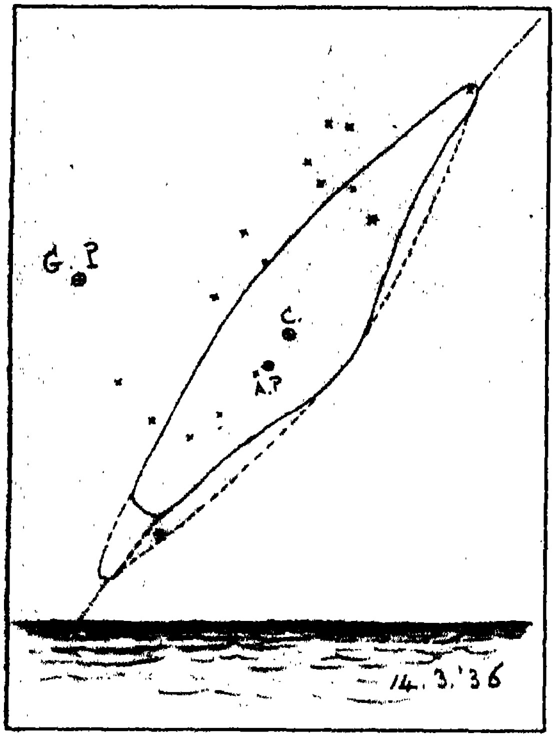



FIG. 1.

in Cancer. It rose steeply, slanting to the right, from about 15° above the horizon. Below this level the sky was pale.

I noticed also that at greater altitudes there was more illumination from the starry sky on the right hand than on the left, or north side of the band, where the interspaces were notably black. I was unaware at the time that the Galactic Pole (G.P.) was situated to the north of the luminous band, in the position shown in the accompanying drawing (Fig. 1).

After about an hour's observation, I marked the limits of the luminous band upon a star atlas, as shown by the continuous line in the drawing. The measurement of the drawing and the determination of the sun's antipode were done after the observations had been completed.

The length of the luminous band was 70°, the brightest part a nearly circular patch half way between Regulus and $\gamma$ Virginis, extending 18° in this direction, the centre of brightness being in R.A. 170°, very slightly to the north of the ecliptic. This is 41° from the preceding, but only 29° from the following extremity of the luminous band. The latter was broader and blunter than the former. Marking a point upon the ecliptic (shown as a broken-and-dotted line) 41° following the centre of brightness, and prolonging the sides of the band from the lower end, the preceding extremity is seen to be repeated here with fair accuracy, and the form now becomes symmetrical about the transverse axis.

There remains a remarkable disparity of form on the two sides of the longer axis. If, however, the positions at 41° preceding and following the centre of brightness be joined to the right-hand bulge of the centre, the figure becomes perfectly symmetrical.

The distribution of brightness in the sky above, below, right and left to which I have referred was exactly such as to account for this encroachment upon the boundaries of an area the intrinsic luminosity of which was symmetrically disposed.

Having ascertained the position of the sun, I marked the antipode (A.P.) upon the drawing. This was 5° following the centre of brightness and 46° from the preceding extremity of the *Gegenschein*. It is conceivable that as the sun sank farther below the horizon, the centre of apparent brightness might have coincided with the antipode, but the matter could not have been tested on the evening of March 14 as the rising of the moon was due shortly.

My drawing shows the axis of the *Gegenschein* to be slightly north of the ecliptic, but the distribution of brightness in the sky deprives this fact of any significance in relation to the theory of the actual plane of symmetry.

On this evening when the counterglow reached a point 46° preceding the sun's antipode, the apex of the Zodiacal Light was at 53° following the sun.

VAUGHAN CORNISH.

Inglewood, Gordon Road,
Camberley, Surrey.
April 7.

## Enhancement of Red Lines and Bands in the Auroral Spectrum from a Sunlit Atmosphere

IT is a well-established fact that the intensity distribution within the auroral spectrum is subject to considerable variations. In 1923 one of us (Vegard) found that the negative nitrogen bands as compared with the strong green line were considerably enhanced with increasing altitude.

In 1926 one of us (Vegard) showed that the red aurora of Type *A* owed its red colour to the enhancement of the red line or group of lines at 6300 A., which may probably be referred to the transitions $^1D_2-^3P_{1,2}$ of oxygen. The red aurora of Type *B*, characterised by a red bottom edge, has been found to owe its red colour to the enhancement of some red bands belonging to the first positive group of nitrogen. Some diffuse auroral forms also show enhancement of the red bands and lines.

In 1929 Størmer obtained a spectrogram from rays which were still under the action of sunlight. His spectrogram, being taken on an orthochromatic plate, did not contain the red part, but only the green line and the negative nitrogen bands. It indicated a considerable enhancement of the latter bands as compared with the strong green line. It was, however, pointed out by one of us (Vegard), that this effect might be accounted for entirely by the altitude

effect mentioned, because the spectrogram corresponds to ray streamers with altitudes of several hundred kilometres. It was, however, a question of importance to make further investigations in order to see whether the auroral spectrum was changed in any way in an atmosphere exposed to sunlight.

During the past winter season a considerable number of spectrograms from auroral *arcs* exposed to sunlight were obtained at the Auroral Observatory at Tromsø, which showed some most important effects. All spectrograms were taken on panchromatic plates, and intensity scales were photographed on each plate in order to enable us to measure relative intensity changes within the spectrum. On the same plates were also taken spectrograms of normal auroras appearing later in the night.

A more complete account of our observational data will appear later. We propose to mention here the most striking facts only, and photometric curves are reproduced (Fig. 1) of two spectra of October 27, 1935, *one corresponding to a sunlit atmosphere* and the other corresponding to ordinary night conditions.

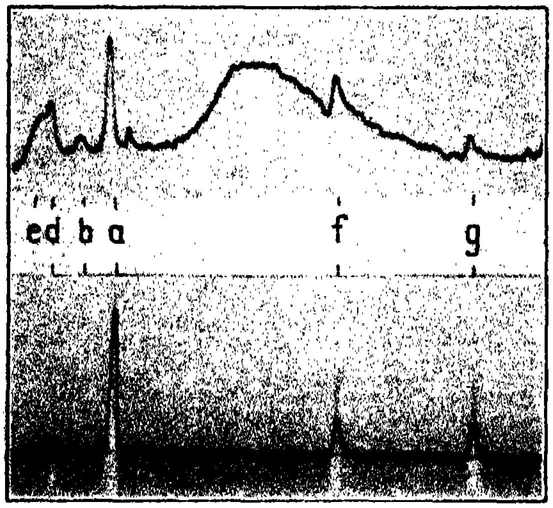



FIG. 1. Photograms of auroral spectra, October 27, 1935. Upper: Sunlit aurora. Lower: ordinary night aurora. $a = 5577$ A.; $d = 6300$ A.; $b$ and $e$ are bands of 1st positive group of nitrogen; $f$ and $g$ are the bands 4278 and 3914 of the negative nitrogen group.

First of all we notice that the enhancement of the negative bands due to sunlight *is* small. Comparing the band 4278 ($f$) and the green line ($a$), we find the ratio:

$$(I_f/I_a) \text{ sunlit} : (I_f/I_a) \text{ dark} = 1{\cdot}46.$$

Taking into account the probable error, this effect is not larger than may be accounted for by the altitude effect, because the altitude of the sunlit arcs according to Harangs' measurements is increased by about 25 per cent. Thus the enhancement of the negative bands due to sunlight scarcely exceeds 20 per cent.

From the photometric curves we notice *that the sunlight produces a most pronounced enhancement of certain bands of the* 1st *positive group* ($b$, $e$) *and of the red line* 6300, which is probably to be interpreted as the oxygen triplet ($^1D_2$–$^3P_{123}$). From the spectrograms here illustrated we find that the *red line* 6300 *relative to the green line is* 4–5 *times stronger from the sunlit atmosphere than from the dark one*.

The bands of the 1st positive group are in the present case enhanced to an even greater degree. So far as can be judged from our present material, the enhancement of 6300 seems to be more constant and to be always present in the light from a sunlit atmosphere, while the enhancement of the bands of the 1st positive group is more variable.

In a number of previous papers[1] one of us has suggested that the enhancement of the red line (6300), causing the red auroras of Type $A$, was due to the action on ozone ($O_3$) of an activated state of nitrogen, with the result that oxygen atoms were brought into the $^1D_2$ state. This explanation is now supported by our discovery of the enhancement of *the red line 6300 in the sunlit atmosphere, for this* effect is probably due to a change in the state of the atmosphere produced by sunlight, and the most conspicuous change consists in the production of ozone by the sun's radiation.

L. VEGARD.
E. TØNSBERG.

Oslo and Tromsø.
April 3.

[1] L. Vegard, *Geophys. Publ.*, **10**, No. 4, 48 (1933). L. Vegard and E. Tønsberg, *Z. Phys.*, **88**, 718 (1934).

## Vitamins and Plants

IN general, vitamins are products of the vegetable *kingdom. Their possible role in plants, however, has* been almost totally unknown until quite recently.

Some years ago we followed the synthesis of carotene (the precursor of vitamin A) and vitamin C (ascorbic acid) in plants, and observed that the percentage content of these compounds in the plant is generally the higher the better the plant grows[1]. Their concentration thus reaches a maximum at an early stage of growth, either before or at the beginning of flowering. Similarly we found that an adequate fertilisation increases the percentage content of vitamin C and carotene. The view that artificial fertilisers would seriously affect the composition of plants is thus not tenable, at least where vitamins are concerned. This fact was clearly demonstrated by Scheunert's prolonged work on rats[2].

On the other hand, we found that all factors which have an unfavourable influence on the growth of plants, such as soil acidity, excessive concentrations of phosphate, potassium, sodium chloride, etc., lower the content of carotene and vitamin C in plants. In my opinion, these facts showed, although indirectly, that carotene and vitamin C are important growth factors of plants.

In the case of vitamin C, this assumption has now been conclusively proved by further work in this laboratory (S. v. Hausen[3]). Addition of crystalline vitamin C to the medium in sterile pea cultures led to an increase of 40–100 per cent in the dry weight of the treated plants. (At the same time it was noted that the roots of the plant protect vitamin C very effectively against autoxidation.) The effect of vitamin C on growth is a specific one, since, for example, glucose has no such effect. It was also shown that the peas actually took up with their roots vitamin C from the medium. Shortly after, L. Havas at Rothamsted made similar observations[4].

These results showed that an addition of vitamin C to the medium promotes markedly the growth of the plant, but they did not conclusively prove that vitamin C is essential for plants. Definite proof for the latter fact has, however, now been obtained through Miss v. Hausen's work on pea seedlings

which were deprived of their cotyledons at a suitable stage, when they contained about ninety per cent of the total vitamin C present in the seedling. Such seedlings generally die or remain completely dwarfed, whereas they will develop distinctly better, and even produce normal blossoms, when small amounts of pure ascorbic acid are added to the medium. Even the treated plants naturally suffer from the removal of cotyledons, which evidently contain also other necessary compounds besides vitamin C. The accompanying table will illustrate the effect of ascorbic acid on the development of cotyledon-less seedlings.

'Torstai' peas (cotyledons removed) in sterile Hiltner's solution with $(Ca(NO_3)_2$; initial *p*H 5·5. Time of growth 29 days.

| | Average length of two plants, in cm. | | Dry weight of two plants, in grams | | Vitamin C in two plants, total (ml. of ind. solution) | |
|---|---|---|---|---|---|---|
| | Treated | Controls | Treated | Controls | Treated | Controls |
| | 83 | 35 | 0·431 | 0·070 | 22·8 | 2·7 |
| | 66 | 80 | 0·305 | 0·063 | 12·5 | 2·0 |
| | 75 | 30 | 0·461 | 0·075 | 22·5 | 2·8 |
| | 82 | 22 | 0·405 | 0·044 | 17·5 | 1·5 |
| Normal plants (cotyledons not removed; ascorbic acid not added) | — | 85 | — | 1·850 | — | 48·0 |
| | — | 92 | — | 1·706 | — | 44·0 |

It is therefore reasonable to regard vitamin C as a phytohormone, which is indispensable to plants. The formation of vitamin C during germination is necessary for the early development of the plant. During later stages of growth, large quantities of vitamin C are produced in connexion with photosynthesis. So far, vitamin C is the only vitamin the indispensability of which to higher plants has been proved through *direct* experiments. Corresponding work on vitamin $B_2$ (lactoflavine) is at present in progress in this laboratory.

W. H. Schopfer[5] has recently shown that vitamin $B_1$ promotes greatly the growth of lower fungi (Phycomyces, etc.). According to his results, the effect is very delicate and specific, so that it can be used for the quantitative determination of $B_1$.

The fact that certain compounds, which act as vitamins in the animal organism, have important functions in plants, is additional evidence of the similarity of the metabolism of plant and animal cells.

ARTTURI I. VIRTANEN.

Biochemical Institute,
Helsingfors.
March 30.

[1] Virtanen, v. Hausen and Saastamoinen, *Ann. Acad. Scient. Fenn.*, A, **37**, No. 7 (1933).
[2] Scheunert, Sachse and Specht, *Biochem. Z.*, **274**, 373 (1934).
[3] v. Hausen, *Suomen Kemistilehti*, B, Nos. 5–6 (1935); No. 12 (1935); NATURE, **136**, 516 (1935).
[4] Havas, NATURE, **136**, 435 (1935).
[5] Schopfer, ref. Karrer, *Schweiz. Mediz. Wochenschr.*, **65**, No. 37 (1935).

## Formal and Practical Thermodynamics

MAY I put in a word for the British way of looking at thermodynamics, now largely confined to engineers, as suggested by the critical remarks on the second edition of the treatise of Prof. Saha and Dr. Srivastava, contained in the brilliant and appreciative review in NATURE of April 4. Especially would I firmly support the Indian authors in passing over the preliminary abstractions of Prof. Carathéodory of Munich and his school. I remember when Prof. Planck, in a new edition of his book on thermodynamics, attracted attention by ultimately blessing them: which led to an invasion into Great Britain that I tried in my own way to counter by a critical commentary in my "Mathematical and Physical Papers" (vol. 2, pp. 603–7; 1928).

The fragmentary treatments by Kelvin and Rankine, even by Maxwell and Willard Gibbs, may be deficient as regards formal logic, but after all they are the efforts of constructive genius in this universal subject, after Carnot. Even the reviewer admits that it is hard to find English equivalents for the German technical terms. Indeed, the logical flavour comes largely from treating thermodynamics as a branch of the statistical mechanics as developed after Maxwell and Boltzmann: while on the other hand no biologist ought to admit that the vital activities to which he applies thermodynamic principles can be adequately described by the mere statistical play of atoms in the main unknown. It is here that the merit of Clausius' introduction of his concept of an abstract universal entropy, as the necessary correlative of unavoidable universal temperature, shines, however unfinished be its present state of development.

Incidentally one may note that the statistical equipartition of energy between the 'momentoids' of the molecules, even when they do not represent momenta, was settled long ago in general discussion between Rayleigh, Bryan and Boltzmann.

JOSEPH LARMOR.

Holywood, Co. Down.
April 5.

## Terminology of Relative Growth

THE quantitative study of relative growth and the proportion of parts has in recent years made considerable progress, and is now beginning to find widespread application in such diverse fields as systematics, embryology, genetics and palæontology, as well as in growth-studies proper. Unfortunately, serious diversities of terminology and notation have sprung up[1,2,3,4,5,6]. We therefore wish to propose the following agreed terminology to avoid confusion.

(1) The terms *dysharmony*[7] and *heterogony*[8] should be dropped. *Dysharmony* was first used to denote the exaggerated proportions of certain organs, and a suggestion of abnormality remains attached to it. *Heterogony* has been widely used to denote a certain type of reproductive cycle[9,10,11], so that its employment in a new sense is not desirable. Accordingly, to denote growth of a part at a different rate from that of body as a whole or of a standard, we propose the term *allometry*, with *isometry* for the special case where the growth-rate of the part is identical with that of the standard or whole. Allometry has the advantage of recalling the allometrons of Osborn[12], those gradual changes in proportion observed in evolution, which according to the work of Hersch[13] and Robb[14] do proceed according to our fundamental law of allometric growth. The term has the further advantage that it can be applied equally legitimately to phenomena of growth (*dysharmonie de croissance*) or to those of proportionate size (*dysharmonie de taille*) as in holometabolous insects. *Positive* and *negative allometry* denote respectively growth-rates of the part above or below that of the standard.

(2) In all cases of allometry the part shows an absolute increase of size with time or with increase of size of the standard. For cases where, instead of this, a decrease of absolute size occurs, for example, in the abdominal limbs of crabs at and shortly after metamorphosis, we propose the new term *enantiometry* (equivalent to *negative growth*).

(3) The *elementary law of relative growth* or law of *simple allometry* can be expressed by a formula of the type

$$y = bx^{\alpha} \quad \text{(for notation see later)},$$

where $y$ is the part, $x$ the standard or whole, and $b$ and $\alpha$ are constants. When $\alpha > 1$, we have positive allometry; when $\alpha < 1$, negative allometry; when $\alpha = 1$, isometry.

(4) The biologically important term in this formula is the exponent $\alpha$. For this we propose the term *equilibrium constant* (in place of growth-coefficient, partition-coefficient, *constante de dysharmonie*, etc.). This general term covers both growth and final proportions. To distinguish the two where necessary, as, for example, in regard to deer antlers, we may use *growth-constant* (or *actual equilibrium constant*) as opposed to *limiting equilibrium constant*. *Growth-ratio* may also be properly used as equivalent of growth-constant in certain circumstances.

(5) The constant $b$ merely represents the value of $y$ when $x = 1$. However, since its value affects the initial size of an organ, we may call it the *initial growth-index*.

(6) The terms *growth-gradient* and *growth-centre*[1] remain.

(7) *Notation.* In the formula of simple allometry, Teissier[2] has employed the notation $y = kx^{\alpha}$, Huxley[1] $y = bx^{k}$, Nomura[3] $a = kb^{m}$, and Weymouth and Mackay[4] $p = aw^{k}$. It will be seen that different symbols are confusingly applied to the same term. We therefore propose that the recognised notation should be $y = bx^{\alpha}$. As is customary, $x$ and $y$ are used for the variables, $y$ being the dependent variable. For the essential equilibrium constant, $\alpha$ is used, since Greek letters stand out against Latin. $k$ is dropped since it has been widely used in two entirely distinct senses. For the initial index, the non-committal $b$ is chosen.

We hope that other workers in this field will see fit to adopt these suggestions.

J. S. HUXLEY.

Zoological Society, London.

G. TEISSIER.

Station Biologique de Roscoff.

[1] J. S. Huxley, "Problems of Relative Growth". Methuen, London (1932).

[2] G. Teissier, 1934. "Dysharmonies et discontinuités dans la Croissance". *Act. Sci. et Industr.*, No. 95. (Exposés de Biometrie, 1) (1934). Hermann, Paris.

[3] E. Nomura. "An Application of $a = kb^{m}$ in expressing the Growth Relation in Molluscan Shells". *Sci. Rep. Tohoku Imp. Univ.* (4), **2**, 53 (1926).

[4] F. W. Weymouth and D. C. G. Mackay, "Relative Growth in the Pacific Edible Crab, *Cancer magister*". *Proc. Soc. Exp. Biol. Med.*, **31**, 113 (1934).

[5] W. J. Crozier and E. V. Enzmann, "On the Relation between Litter-Size, Birth-Weight, and Rate of Growth in Mice". *J. Gen. Physiol.*, **19**, 249 (1935).

[6] M. Raja, "Sull'accrescimento postembrionale del *Loligo vulgaris*". *Boll. Zool. Torino*, **5**, 1 (1934).

[7] C. Champy, "Sexualité et Hormones". G. Doin, Paris (1924).

[8] A. Pesard, "Le conditionnement physiologique des caractères sexuels secondaires chez les Oiseaux". *Bull. Biol. Fr. et Belg.*, **52**, 1 (1918).

[9] R. Leuckart, 1876. "Die Menschlichen Parasiten" (Bd. 2), Leipzig (1876).

[10] J. Meisenheimer, "Geschlecht und Geschlechter". Jena (1921).

[11] A. Weismann, "Beitr. zu. Naturgeschichte der Daphnoiden", Leipzig (1878).

[12] H. F. Osborn, "The Origin of Species". (2) "Distinctions between Rectigradations and Allometrons". *Proc. Nat. Ac. Sci.*, **11**, 749 (1925).

[13] A. H. Hersh, "Evolutionary Relative Growth in the *Titanotheres*". *Amer. Nat.*, **68**, 537 (1934).

[14] R. C. Robb, "Two Modes of Evolution in the Horse". *Proc. Sixth Internat. Congr. Genetics*, **2**, 166 (1932).

## Structure of the Formate Ion

IN two recent letters to NATURE, B. C. Rây[1,2] and P. B. Sarkar[2] proposed a structure $\left[:C\begin{smallmatrix}\nearrow O\\ \searrow OH\end{smallmatrix}\right]^{-}$ for the formate ion in solution, while retaining the normal structure for the acid, its esters and the formate ion in the crystal; they suppose that on solution the formate ion undergoes the prototropic change $\left[H-C\begin{smallmatrix}\nearrow O\\ \searrow O^{-}\end{smallmatrix}\right] \rightarrow \left[:C\begin{smallmatrix}\nearrow O\\ \searrow OH\end{smallmatrix}\right]^{-}$.

Such a prototropic change is usually pictured as an intermolecular process, and if the hypothesis of Sarkar and Rây is true it would be expected that the hydrogen of the formate ion would exchange very rapidly with deuterium in heavy water. The experiments of Wynne-Jones[3], Münzberg[4] and ourselves (unpublished) all go to show that the exchange process between formate ion and heavy water is extremely slow. We have found, for example, that 8 per cent exchange took place in 8 days at 100° with potassium formate in neutral solution, the exchange being accelerated by the presence of alkali. Münzberg was unable to detect any exchange in neutral solution after 300 hours at 50° C. It would seem, therefore, either that the prototropic change must be exclusively intra-molecular, which we regard as very unlikely, or that the postulated prototropy does not take place.

A second argument against the hypothesis of Sarkar and Rây, which is independent of the mechanism of the prototropic process, is to be found in the fact that an ion of the structure proposed would be expected to have an appreciable acid dissociation constant. Inasmuch as the hydroxyl group of phenol ($K_A = 10^{-10}$) and even those of the sugars exchange quite rapidly in heavy water, the slowness of the exchange of the formate ion seems to provide a second argument against the proposed structure of the formate ion. If the considerations we have put forward are valid, they constitute a further example of the application of deuterium to problems of molecular structure and mechanism.

P. A. SMALL.
J. H. WOLFENDEN.

Physical Chemistry Laboratory,
Balliol and Trinity Colleges,
Oxford.
March 26.

[1] NATURE, **133**, 646 (1934).

[2] NATURE, **137**, 495 (1936).

[3] *Chem. Rev.*, **17**, 115 (1935).

[4] *Z. phys. Chem.*, **31**, B, 18 (1935).

## Production of Electron Pairs

IN a recent paper[1] we discussed the creation of positive–negative electron pairs by a beam of $\gamma$-rays traversing lead, with atomic number $Z = 82$. Results have since been obtained with $Z = 50$ and $Z = 65$ for $\gamma$-rays of energy $h\nu = 3mc^2$. It is of interest to compare these with the values given by Bethe and Heitler[2], using the Born approximation. We give below the two sets of results, together with the corresponding values of $\bar{E}_+ - \bar{E}_-$, where $\bar{E}_+$ and $\bar{E}_-$ are the average energy of the positron and electron respectively.

| | | | |
|---|---|---|---|
| $Z$ .... .... .... | 50 | 65 | 82 |
| $\sigma \times 10^{24}$ .... .... | 0·17 | 0·34 | 0·67 |
| $\sigma \times 10^{24}$ (Born) .... | 0·13 | 0·21 | 0·34 |
| $(\bar{E}_+ - \bar{E}_-)/mc^2$ .... | 0·22 | 0·28 | 0·33 |

The accurate values have been calculated as described by Jaeger and Hulme (*loc. cit.*) using Dirac wave functions. The numerical work is tedious, and only the most important electronic transitions have been taken into account in calculating the absorption cross-section per atom ($\sigma$), which should be correct to within 5 per cent. Screening has been neglected, which is quite justifiable for low energies. It will be seen that $\sigma$ approaches the value given by the Born approximation quite rapidly, the difference varying as $Z^4$. The three values calculated lie on the curve

$$\sigma \times 10^{24} = 0{\cdot}95(Z/137)^2 + 2{\cdot}54(Z/137)^4,$$

the first term giving the Born approximation. An empirical formula of this type could probably be used to fit results at higher energies. The increase in $\overline{E}_+ - \overline{E}_-$ is roughly linear, as we should expect (see Bethe and Heitler, *loc. cit.*, p. 108).

We may summarise by saying that the Born approximation always gives results which are too low, but the error decreases rapidly with decreasing atomic number and increasing energy of the $\gamma$-ray.

J. C. JAEGER.

University of Tasmania,
Hobart.

[1] Jaeger and Hulme, *Proc. Roy. Soc.*, A, **153**, 443 (1936).
[2] *Proc. Roy. Soc.*, A, **146**, 83 (1934).

## The *D* Region of the Ionosphere

DURING the last ten years, investigations based upon the mathematical theories of Eccles and Larmor have given considerable information regarding the reflecting layers of the atmosphere. The most interesting discovery was that of Prof. E. V. Appleton, who showed that there is an upper reflecting region in addition to the Kennelly-Heaviside layer.

From experiments which we have conducted during the last year, we are led to believe that there is a third region at a height of 5–50 km. which strongly reflects radio waves. Such a layer has been postulated before as an absorption layer in the ozone region, but its reflecting powers have not been emphasised.

Our apparatus consists of a sending station which gives out sixty pulses per second, each pulse lasting ten microseconds. The signal is received upon a rotatable loop or a standard antenna located two hundred metres from the sending station. After passing through a special receiver having a wide band pass and short lag characteristics, the signal is observed visually upon a cathode ray oscilloscope. The rapid sweep of the oscilloscope separates the reflected and the ground rays.

From the many observations which have been made, the following important conclusions may be drawn:

(1) The lower part of the *D* region is well within the normal winds of the troposphere. It occasionally rises to a height of 50 km. in low-pressure areas and drops to 5 km. in high-pressure areas. It is the rise and fall of this region which causes the change in signal strength of nearby broadcasting stations such as *KDKA* (150 km. north of Morgantown).

(2) Generally there are reflections from two parts of the region at virtual heights of 5–30 km. and 40–55 km. During periods of low barometer these two reflections may combine.

(3) At times the region is very erratic. The polarisation and intensity change with great rapidity. This is especially true near the hours of sunrise and sunset.

(4) The *E* and *F* layers (Kennelly-Heaviside and Appleton layers) are shielded by the lower region. When the intensity of the *D* reflections increases, that of the two other layers decreases.

(5) The two waves employed were 1,614 kc. and 3,492·5 kc. The penetration and variations are greater on the higher frequency.

(6) Periodic fading has been observed on stations within 150 km. due to the change in the interference pattern when the *D* region is either rising or falling.

Messrs. N. I. Hall and L. R. Hill collaborated with us in making these measurements.

R. C. COLWELL.
A. W. FRIEND.

Department of Physics,
West Virginia University,
Morgantown.

## Origin of the Term 'Solute'

IN 1894, at the instigation of Sir Henry A. Miers, my teacher in crystallography at the Central Technical College, London, I prepared a translation and enlargement of Fock's "Einleitung in die chemische Krystallographie" which was published by the Clarendon Press under the title of "An Introduction to Chemical Crystallography" in 1895.

The late Prof. N. Story-Maskelyne, who then held the chair of mineralogy in the University of Oxford, kindly wrote a preface, dated Nov. 18, 1894, to this little work. In this preface occurs the phrase "what for lack of a much-needed term I may call the *solute* (namely the substance or substances dissolved)". The word solute is italicised in the original.

Crystallographers have always been facile inventors of new words, and to Story-Maskelyne, a master of the art, must be ascribed the parentage of the term referred to in NATURE of April 25 (p. 698).

W. J. POPE.

The Chemical Laboratory,
Cambridge.

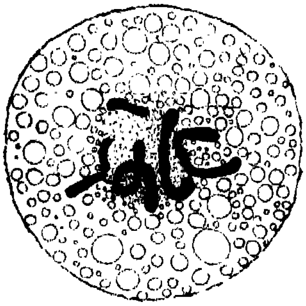
THE "Introduction to Chemical Crystallography", to which Sir William Pope refers, was reviewed in NATURE of August 1, 1895 (52, 315), and in the notice the word 'solute' occurs italicised as here shown: "the conditions of equilibrium in a solution containing various *solutes* (to employ a convenient word suggested by Prof. Maskelyne in his preface as a term for the substances dissolved)". Though the preface was dated November 18, 1894, the book containing it was not published until 1895. Before this date, Prof. F. G. Donnan had proposed the use of the word 'solute' in a letter from Leipzig published in NATURE of December 27, 1894. The letter is so short that we reproduce it in full. "Corresponding to the words 'solvent' and solution, some word is very badly wanted to express 'the dissolved substance'. The analogous word is evidently 'solute', and it is as short and euphonious as the others. May I inquire why it is not in general use? Surely someone must have proposed it."

To Prof. Donnan, therefore, appears to belong the credit of first publication of the suggested use of the word 'solute' in the sense in which it has since been employed.

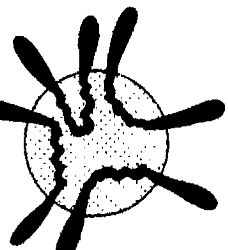
[ED. NATURE.

## Chromosome Cycle of *Ascaris megalocephala*

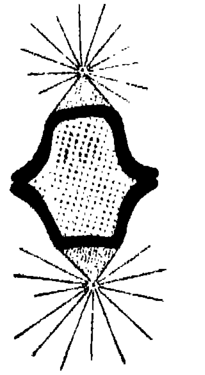
PAINTER[1] and Schrader[2] have recently suggested that the long chromosomes of the germ-line cells in *Ascaris megalocephala* are peculiar in having a large number of spindle attachments instead of only one as hitherto assumed. Some time ago, I carried out an experiment to test this hypothesis. Uteri of adult females (var. *bivalens*) were irradiated with a Coolidge tube (65 kv., 5 ma., 30 cm. distance, unscreened radiation for 5 minutes). They were then kept for 5½ days at 38° C. and fixed in Carnoy. In several cases the long chromosomes of the first cleavage division were fragmented as a result of the irradiation. Fig. 1 shows a cell in which one of the four chromosomes has been broken in two places, leaving three fragments which are *all attached to the spindle*.



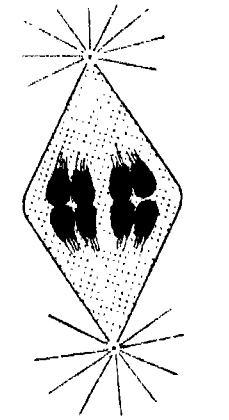
1



2



3



4

DIAGRAMS OF CHROMOSOME CYCLE OF *Ascaris megalocephala*.
1. Metaphase plate of first cleavage division in material irradiated with X-rays.
2. Metaphase plate of first cleavage division. The stippled part represents the spindle-area.
3. Anaphase of first cleavage division.
4. Spermatogonial anaphase.

It seems that the spindle attachments are confined to about the middle third of the length of the chromosomes. As a result, this region usually forms a characteristic zig-zag inside the spindle region at metaphase (Fig. 2). At anaphase the chromosomes do not form V's, but have the shape shown in Fig. 3.

The existence of multiple spindle attachments does not explain why the chromosomes in the ancestral cells of the somatic tissues fragment at the second to the fifth cleavage divisions, but it does explain why, when this fragmentation takes place, each piece has its own spindle attachment. Probably the club-shaped end portions of the chromosomes (genetically inert so far as the soma is concerned ?) are left without spindle attachments at the time of fragmentation; their degeneration in the cytoplasm is possibly a result of this.

There can be no doubt that the multiple spindle attachments are functional throughout the germ-line cycle (and not merely at the cleavage divisions). They are very obvious during spermatogenesis (Fig. 4), although the chromosomes have a totally different shape then.

It is interesting that in spite of the multiple spindle attachments, the chromosomes of *Ascaris megalocephala* do not fragment during spermatogenesis or oogenesis; probably the spindle attachments are so close together that all those in one chromatid are mechanically compelled to go to the same pole at anaphase.

The existence of multiple spindle attachments in *Ascaris* naturally suggests that the spindle attachments of some other organisms may also be compound, although so close together that they behave as a unit at division. If this were so, it might explain some cases of the evolution of chromosome numbers which are otherwise very difficult to understand.

M. J. D. WHITE.

University College,
London.

[1] T. S. Painter, "Chromosome Fusion and Speciation in *Drosophila*". *Genetics*, 20, 327 (1935).
[2] F. Schrader, "Notes on the Behaviour of Long Chromosomes". *Cytologia*, 6, 422 (1935).

## Control of the Enzymic Action of Lipase

A SUBSTANCE has been isolated from the castor oil seed, which controls the reversible action of lipase. The reduced form of this substance, which seems to be the predominating one in seeds, acts as an activator of the hydrolysis of fat by the *Ricinus* lipase and as an inhibitor of the synthesis of fat from glycerol and oleic acid. The oxidised form, which is easily obtainable from the reduced form by autoxidation in air, acts as an activator for the synthesis and as an inhibitor for the hydrolysis. The intermediary form is indifferent for both synthetic and hydrolytic processes.

The substance is a colourless rhombic plate crystal. The melting point 130° C.; $[\alpha]_D^{18} = -77°$. It is soluble in alcohol, methanol, glycerol, ether, acetone, benzene, chloroform, but not in petroleum ether. The solution in alcohol shows blue-violet fluorescence and two selective absorption bands with maxima at 314 mμ and 285 mμ.

The sterol reaction of Liebermann-Burchardt, the Cuboni reaction for œstrogenic hormone, and the vanilin-phosphoric acid reaction for bile acid are positive, but the Salkowski reaction for sterol and Gregory reaction for bile acid are negative.

Details will be published later in the *Japanese Journal of Biochemistry*.

RYOJI ITOH.

Institute of Medical Chemistry,
Kyushu Imperial University,
Fukuoka.

## Sulphur-containing Pigments of Plant Origin

WITH the view of throwing light on the nature of the transient blue pigment, cyanohermidin, formed on exposing to the air an anærobically prepared extract of *Mercurialis perennis*[1], we have recently undertaken the investigation of the more stable blue compound formed on drying the actively growing shoots of this plant collected during the early spring. We have found that this compound changes spontaneously on keeping, or more rapidly on heating its aqueous solutions,

into a red product from which we have been able to separate a series of pigments, by a combination of chemical and physical methods. These pigments are glycosides which contain, in addition to carbon and hydrogen, both nitrogen and sulphur. The occurrence of the latter element in a pigment of vegetable origin has, so far as we are aware, not been recorded before, and we think this observation of sufficient interest to warrant its publication in this form, reserving the detailed description of these new substances for a future occasion.

P. HAAS.
T. G. HILL.
BARBARA RUSSELL-WELLS.
Botanical Department,
University College,
London.
March 31.

[1] Haas and Hill, *Biochem. J.*, 19, 236 (1925).

## A Specific Reaction for the Qualitative and Quantitative Determination of Ascorbic Acid in Serum

ON the findings in some yet unpublished studies on the reducing power of ascorbic acid in phosphate-chloride mixtures, we have developed a specific method for demonstrating ascorbic acid in very weak concentrations. If a little ascorbic acid is added to a solution of methylene blue and the solution is exposed to strong light, the colour will disappear completely within 30 seconds. This decolourisation is promoted by low *p*H and the presence of sodium chloride. Examination for serum ascorbic acid is therefore made with a stock solution consisting of $KH_2PO_4$ 9 gm., NaCl 2 gm., c. 0·004 per cent methylene blue solution in 100 ml. 0·1 ml. of this solution is added to 0·9 ml. serum.

The mixture is exposed to the light of a 100-watt Nitra lamp, at a distance of 1 cm., for 30 seconds, and the intensity of the colour is compared to that of a control. Fading of the intensity of colour is distinct even with 0·1 mgm. per cent. The colour change is reversible in the dark.

This reaction to light is not produced by glutamine, ergotionine, creatine, creatinine, urea, adenine, guanine, hypoxanthine, xanthine, uric acid, cystine, phenol, hæmoglobin; nor does any of these substances inhibit the reaction with ascorbic acid. A negative serum reaction became strongly positive 4 hours after the experimenter had taken 500 mgm. ascorbic acid by mouth.

The method may be employed for the quantitative estimation of ascorbic acid, through establishment of the titre by means of dilutions; and apparently also, in modified form, for determination of the ascorbic acid content of milk and urine.

HELGE LUND.
HERBERT LIECK.
Institute of Hygiene,
University of Copenhagen.
April 11.

## Points from Foregoing Letters

WHEN water moving with low uniform velocity encounters an obstacle, a 'capillary' wave appears, looking like a very fine thread or hair floating on the surface. W. Schmidt submits photographs showing this phenomenon when a gentle breeze is blowing over a lake or when a slow moving stream discharges into it. He points out that only a very thin surface layer is involved, and that this region of retarded motion shows mechanical properties analogous to those of an oil patch.

A drawing of the shape and position of the *Gegenschein* (faint luminescence of the sky seen opposite the direction of the sun) observed at sea, off the coast of Portugal, is given by Dr. Vaughan Cornish. Allowing for distortion due to uneven brightness of the surrounding sky, the luminosity of the *Gegenschein* appears to be symmetrically disposed.

Photograms comparing the intensity of light in the auroral spectrum at night with that under the influence of the sun are submitted by Prof. L. Vegard and E. Tønsberg. They find in daytime an enhancement of certain bands, the red line 6300 A. being four to five times stronger relative to the green line. This, the authors consider, is probably due to the influence of the ozone produced by the sun's rays.

Experiments with pea seedlings, carried out by Miss S. v. Hausen to prove the growth-promoting properties of vitamin C, are reported by Prof. A. I. Virtanen. By removing the cotyledons at a suitable stage, the seedlings are deprived of 90 per cent of their vitamin C, and die or remain dwarfed. The addition of vitamin C enables them to develop and even to produce normal blossoms.

Prof. J. S. Huxley and Dr. G. Teissier suggest the term *allometry* to denote growth of a part at a different rate from that of the body as a whole, and *isometry* when the growth-rate is the same. They further discuss the meaning of several other terms, and suggest a uniform notation for the factors involved in the elementary law of relative growth.

The absorption cross-sections of $\gamma$-rays (to produce negative and positive electron-pairs) per atom of tin (atomic number $Z = 50$), terbium ($Z = 65$) and zinc ($Z = 82$) have been determined by J. C. Jaeger. He finds that, by comparison, the Born approximation gives results which are too low, but the error decreases rapidly with decreasing atomic number and increasing energy of the $\gamma$-rays.

Prof. R. C. Colwell and A. W. Friend state that, with a short radio pulse and a rapid sweep on the receiving oscilloscope, it is possible to resolve the 'ground' wave into two or three parts, one or two of which are waves reflected from a low-lying region in the ionosphere. These layers are about 20 km. and 45 km. above the ground on the average, and are strongly reflecting for waves in the broadcast band. The lower one rises and falls with changes in the barometric pressure.

On irradiating with X-rays the uteri of horse roundworms, M. J. D. White finds that long chromosomes of the first cleavage division have broken up into three fragments, still attached to the spindle (a fibrous structure which plays an important part in nuclear division). He gives diagrams of chromosome arrangements during stages of nuclear division to support this indication of multiple attachment of chromosomes to the spindle.

# Research Items

### Gypsy Dancers in the Pyrenees

MISS VIOLET ALFORD, who has given twelve years to study of the folk-lore and customs of the Pyrenees, has recently described some of the material relating to gypsies which she has collected during that time (*J. Gypsy-Lore Soc.*, Ser. 3, 15, 2). For the most part, it belongs to the two ends of the range. Although the central Pyrenees does not lack gypsies, the only encounter with them there was in the valley of the Lez, Ariège. In Catalonia, on the Spanish side of the border, two dances hold first place, the first belonging to the Vallés district, the second to the Penedés district, south of Barcelona. The Vallés *Bal de les Gitanes* appears only at carnival time, when teams visit outlying farms, dance on the threshing floor and afterwards collect sausages and wine for a festal supper. Traditionally they steal cabbages from the gardens where they dance. In the dance of the Penedés district one of the dancers carries a maypole fitted with ribbons which the dancers hold in one hand, while carrying a castanet in the other. The fool carries a thong to lash the dancers and the crowd. In the Basque country the gypsies are regarded with abhorrence, and this is brought out in the role assigned to the despised outsiders, including 'Bohemians', in the *Masquerades*. The gypsies are led by a Gypsy Chief and brandish wooden swords and play wild pranks. A gypsy woman once figured also among 'les beaux', the superior troop in the *Masquerades*, probably as a man-woman fertility figure. In Basse-Navarre and Labourd Basque carnival dancers perform under the name *Kaskarotak*, the regional term applied to gypsies. They perform stick dances in carnival time. At the top of the Nive valley the best dancers become *Volants*. At Ispoure, a traditional colony of gypsies who arrived in the train of the Moriscos and Jews exiled from Spain in 1570–1614 are dancers par excellence and have risen to the rank of 'volants'.

### Ojibwa Puberty Customs and Beliefs

IN the course of a study of the religious and social life of the Ojibwa Indians of Parry Island, Ottawa, part of which is now a reserve, Mr. Diamond Jenness describes a number of practices and beliefs relating to pubescent girls (National Museum of Canada, Bull. 78, Anthrop. Series 17). The Parry Island Ojibwa, who number about two hundred and fifty, though about one hundred consider themselves Potawatomi, are descendants of bands who migrated to Canada more than a hundred years ago from Michigan. They now form a single band, electing their chief annually, though formerly he held that position for life, and other things being equal, the position was hereditary. The whole life of the people was strongly affected by their relation to Nature and the underlying spiritual world. A large number of taboos had to be observed; and dreams held an important place in the beliefs and behaviour of members of the tribe. The traditional behaviour of a girl at puberty must follow that of the first Indian maiden to attain adolescence, who was warned and taught by 'Grandmother Moon'. Unless a girl listens to 'Grandmother Moon' when she whistles to her in a dream, she may never reach old age. The first period of seclusion lasts ten (formerly twenty) days, though later periods last for four days only. In harvest time the girl must remain in her special wigwam (nowadays a separate room in the house), until the close of harvest. No man or child younger than herself must approach her. Fresh food of all kinds were forbidden and other taboos had to be observed. She was in grave danger. Yet this mysterious power was not always harmful. It might be diverted to cure a middle-aged man suffering from an apparently incurable weakness, if he lay on his face in her room, so that he could not see her, and she walked slowly up and down his spine. Her power penetrated his frame, healed his malady, and enabled him to rise to his feet with all the vigour of a young man. Girls who had visions during their periods of seclusion sometimes attained great influence in the bands, and taking part in warfare, led the tribe to victory.

### Indians in Canada

THE Indian population of Canada numbered 112,510 in 1934, according to the Annual Report of the Department of Indian Affairs for the year ending March 31, 1935 (Ottawa, 1935). There was no large epidemic, and it is noted that tuberculosis is not increasing, as is often said, but actually, though slowly, decreasing, except among those Indians who live in the far north and the remoter parts of British Columbia. Education is increasing, with more schools and better attendance. In Quebec and Ontario the Indians are largely engaged in farming; farther west and north, farming and stock raising are less important than hunting, trapping and fishing, but in most provinces the Indians turn their hands to various forms of livelihood, including steel making among the dwellers in the Caughnawaga reserve near Montreal. Timber cutting on the reserves is important. Indian farming operations tend to decrease and the yields per acre are low.

### Ascidians of Mutsu Bay

DR. ASAJIRO OKA in his report on these ascidians (Biological Survey of Mutsu Bay, 28. Ascidiæ Simplices. *Sci. Rep. Tôhoku Imp. Univ.*, fourth series (Biology), Sendai, Japan, 10, No. 3, 1935) describes a large collection obtained by the Survey in 1926 and 1927, consisting of nineteen species belonging to nine genera, nine of the species and one genus being new. With this collection is incorporated another lot collected by Prof. Takatsuki in the same region, containing further species not previously represented. Finally, a specimen of *Cynthia michaelseni* was included which had not previously been recorded. The species are divided into three groups—those characteristic of northern Japan, those whose area of distribution covers entire Japan, and cosmopolitan species. The greater part of the Mutsu Bay forms are limited to northern Japan and to that part of the Japanese coast lying north to Sendai on the Pacific and Akita on the Japan side, the most conspicuous being *Cynthia roretzi* and *Chelyosoma siboja*. The much smaller *Styela plata*, disk-shaped

and attached to the shell of Pecten, is also very characteristic. *Corella japonica*, var. *asamusi*, n.var., grows to a large size and differs very much from the type originally described by Herdman, which is small and covered with mud, the variety having a luxuriant growth of dendritic processes, transparent test and bright red internal body showing through.

### Economic Fishery

FOR stocks of fish, no less than for crops of hay, there is an optimum age at which they can be harvested with greatest profit. It has been suggested that the North Sea might be fished more economically with less effort: that the intensity of fishing might be reduced, and yet, when a new equilibrium has been attained, the yield of the fishery thereby considerably increased. The increase in size of the fish would more than compensate for the smaller number caught. Michael Graham, making special use of his investigations on the cod, contributes a new theoretical formulation of this question (*J. Cons. International pour l'Exploration de la Mer*, **10**, No. 3, 264–274). Conclusions are reached which establish the validity of the view stated above. After attention has been directed to certain evidence provided directly by fishery statistics, two independent lines of reasoning are followed up. The first involves direct calculation of the yield from a formula relating the rate of capture with rates of recruitment, growth and natural mortality. It emerges that if fishing could be reduced to raise the average age of the stock one year, the new yield will rise to a level higher than at present for any permissible valuation of the natural mortality rate. The conclusion holds good for cod, haddock and plaice, which together comprise more than 60 per cent of the North Sea trawl catch. Secondly, consideration is taken of the effect of the War-period on landings from the North Sea. Estimates are made from which it is possible to construct a curve representing the hypothetical natural growth-rate of the stock. Taking this curve as a basis, values are obtained of the yearly increase in total weight for different stages in growth of the stock. The effect can then be seen of regulating fishing effort so that the average age rises from the present 2½ years to about 3½. It is concluded that a saving of about 16 per cent in fishing effort will result in a few years in a gain of 13 per cent in the weight of the catch. This contribution to the theory of handling fish stocks and the application to present problems is certainly noteworthy. It is a sign that accumulation of the data of fishery research is beginning to provide us with material of sufficient variety and adequacy to allow of significant theoretical deductions.

### Partial Sterilisation and Seedling Growth

THE practice of partial sterilisation by means of steam heat is at present used to a considerable extent for the control of many harmful fungi, and for the eradication of soil insects and weed seeds from potting compost. It has been, for some time, part of the routine of the John Innes Horticultural Institution at Merton, London, but as certain disadvantages were also attached to its use, Messrs. W. J. C. Lawrence and J. Newell have carried out an extensive investigation into the process (*Scientific Horticulture*, **4**, 165–177, 1936, from the Editor, S.E. Agric. Coll., Wye, Kent, 3*s*. 6*d*. net). They have established the facts that no lime in any form must be added to a soil before sterilising; that the ingredients of a compost should be sterilised separately; that fertilisers must be added *after* sterilisation; and that additional phosphate must be given in order to balance the natural deficiency of compost, and also to improve the soil conditions, changed by the sterilisation. The practices of horticulture become more scientific with the advance of time, and the paper under review opens a new field for more detailed research.

### New Fungus Diseases of Wheat

A SHORT paper by Miss Mary D. Glynne (*Trans. Brit. Mycol. Soc.*, **20**, Pt. 2, 120–122, January 1936) announces the record of three species of fungi parasitic upon the wheat crop in England. *Cercosporella herpotrichoides*, Fron. has been noted as a cause of foot rot disease in France, the United States, Germany, Holland and Denmark. It appeared at the Rothamsted Experimental Station last year. *Gibellina cerealis*, Pass. has been previously recorded in Italy and Oregon, U.S.A., where it causes 'white straw disease'. *Ophiobolus herpotrichus* (Fr.), Sacc. has been found upon wild grasses in America and England, but has not previously been recorded upon cereals.

### Climate of the St. Lawrence

THE first of a new series of memoirs, *Canadian Meteorological Memoirs*, 1, No. 1, deals with the climate of the Gulf of St. Lawrence and the surrounding regions in Canada and Newfoundland, as it affects aviation. It is by W. E. Knowles Middleton. The region dealt with is of especial meteorological interest for the British Isles apart from aviation, as it is very commonly on the track of wind currents of polar origin that reach Great Britain from some westerly point, having been originally strong winds or gales from the north or north-west, frequent evidence for which is to be found in the part of this memoir that deals with wind statistics. It is also of more general interest as a region of astonishing contrasts, and contains a variety of different climates. Maritime influences are less apparent than might be expected. The cold Labrador current in passing down the east coast of Newfoundland causes frequent coastal fog in summer, and the Gulf Stream is regarded as an aid to fog formation along the Atlantic coast of Nova Scotia and in the Bay of Fundy, but the general west to east atmospheric drift and the presence of the large land mass of North America to the west cause the Continental effect to be in the ascendant. The maritime influence diminishes very rapidly with distance from the coast, a fact which makes it very difficult to form an idea of the climate of any particular place except by an examination of instrumental records covering a number of years. In the case of fog, for example, an item of especial importance for aviation, there is a quick change in the annual distribution of fog frequency on leaving the coast, where there is a very pronounced maximum in the summer, for the interior is subject to radiation fogs due to nocturnal cooling under a clear sky and having their maximum in the winter. Among the many points that are of outstanding interest, two deserve notice; first, the shallowness of most of the infrequent easterly winds, which are rapidly replaced by westerlies at higher levels, and the huge annual range of temperature, which is as great as 145° F. at Doucet, and is of respectable size even in the most easterly and maritime places, for example, 67° F. at Sable Island.

### Upper Winds in India

A STATISTICAL compilation of value for aviation on the air route from England to Australia is No. 66 of Vol. 6 of "Scientific Notes of the India Meteorological Department". The author, whose name is not given, does not discuss in detail the ninety pages of tabular matter that constitute the bulk of this paper, which is entitled "Normal Monthly Percentage Frequencies of Upper Winds at 4, 6, 8 and 10 kilometres above sea-level obtained from Pilot-Balloon Ascents", but he includes in a short foreword a reference to earlier notes dealing with the same subject, which indicates that this is the most comprehensive statistical survey of upper winds between Aden and Rangoon that has yet been made. The figures are based on balloon ascents made in the morning at 34 well-distributed stations up to the end of 1931, and the velocities are grouped into six classes: less than 18, 18–36, 36–54, 54–90, 90–144 and over 144 km./hr., and according to the wind direction. In many instances no observations have yet been obtained at 10 km. in individual months, this being particularly noticeable in summer for those regions that have a long rainy season, but in many others this level is very well explored; for example, in January there are no fewer than 83 observations for Bangalore, 47 for Agra and 45 for Poona, while in July Lahore has 69 and Agra 66 observations. A discussion of the figures will doubtless be given in a paper on the circulation of the atmosphere over India and neighbouring regions which, it is stated in the foreword, will appear shortly.

### Magnetic Screening of Apparatus

PROTECTION of apparatus from the effect of external magnetic influences has always been a difficult problem for instrument designers. The ever-increasing progress in the applications of electrical energy, the great sensitivity of controlling and measuring instruments, and the use of modern radio equipment, make magnetic screening highly desirable in many cases. In a paper in the *Nickel Bulletin* published by the Mond Nickel Company, of Thames House, London, W. F. Randall describes new nickel-iron alloys which are most useful for this purpose. These alloys have permeabilities thirty or forty times greater than the values previously obtained with soft iron. If a small compass needle be placed in a 'mumetal' box a few inches away from a powerful magnet, no effect is discernible. A good galvanometer constructed several years ago before the advent of 'mumetal' had two screening shields weighing 145 lb. and giving a shielding factor of 32; the weight of the mumetal screen is 7¾ lb. and the shielding factor is 960. An exceptionally good mumetal screen gave a shielding factor of 4,500. Nickel-iron alloys have been successfully employed to protect watches from magnetisation. These alloys take a high polish, and form a handsome casing. The older magnetic materials were unsuitable as polarised magnetisation was produced which was detrimental to the working of the watch. Mains transformers in all-electric wireless sets are a fruitful source of stray flux. This trouble can be remedied by an effective magnetic screen either in the form of an enclosing box or, a little less effectively, as a baffle plate of metal between the transformer and the actual receiver.

### Organic Glasses

UNDER this title, G. T. Morgan, N. L. J. Megson and E. L. Holmes (*J. Soc. Glass Tech.*, 20, 19; 1936) give a general review of the constitution and properties of hard, transparent resins. These may be divided into two groups, called condensation resins and polymerisation resins. The condensation resins comprise (*a*) derivatives of formaldehyde with phenol for example, bakelite), with urea (for example, pollopas), thiourea or toluenesulphonamide; and (*b*) derivatives of polyhydric alcohols and polybasic acids (the 'glyptals'). The products of the phenol formaldehyde type, first developed industrially by Bakeland in 1908, are still produced on much the larger scale. Goods made from them, which must be cast (as the product cannot be moulded satisfactorily), are generally of the cheap type. The urea, thiourea or phenolic resins are increasingly used for domestic ware. The 'glyptal' type of colourless condensation resins are derived from polyhydric alcohols and polybasic acids such as glycerol and phthalic anhydride. Resins derived from polymerisation processes are among the earliest known, coumarone and indene derived from coal tar being well-known materials employed, yet the production of glass-clear products is only recent. Styrene, also obtained from coal tar, has recently been polymerised, Germany and the United States having been pioneers in the commercial development, particularly in electrical insulation. Other modern polymerisation resins are derived from vinyl halides, ethers and esters, and more recently from acryl derivatives. Many of these products are glass-clear and resilient, and can be turned on a lathe. The article contains tables giving the properties of various products, and includes suggestions for future progress based on what is known on the mechanism of formation of the products.

### Microscopic Differentiation of Glues in Plywood

A METHOD of identifying casein and blood albumin glues in plywood by microscopic examination is described in a note by B. J. Rendle and G. L. Franklin (*J. Soc. Chem. Ind.*, 55, 105–6; 1936). Casein and blood albumin are two of the adhesives most commonly used in the plywood industry. They are characterised by a high water resistance, and this feature makes it possible for sample blocks of plywood to be sectioned for microscopic examination without separation of the plies. Under the microscope, casein glue is seen to be nearly colourless with a fine granular structure. Under crossed nicols it is slightly anisotropic, producing a sparkling effect against a dark background. Blood albumin is distinctly green in thin sections, with an opaque glassy structure. Under crossed nicols it shows complete extinction. A mixture of eosin and methyl blue is an effective stain for distinguishing between the two types of adhesive and for demonstrating the penetration of the glue into the pores of the wood. A convenient method of application is to mix the two stains together in glycerine jelly, the latter serving as the medium for mounting the sections. A two per cent aqueous solution of methyl blue is mixed with a two per cent solution of eosin in fifty per cent alcohol, in the proportion of three to one. The mixed solution is then added to glycerine jelly, previously liquefied by immersion in a water bath, until it is about the colour of blue-black writing ink. Casein glue is stained a purplish-pink colour, intermediate between 'amaranth pink' and 'pale amaranth pink' in Ridgway's "Colour Nomenclature, 1912", and blood albumin a wine-red or 'vinaceous purple' (Ridgway). The wood itself stains pale mauve in contrast to the relatively deep colour of the glue layer.

# The Kodachrome Process of 16 mm. Colour Cinematography

THE introduction has recently been announced by Messrs. Kodak, Ltd., of a new method of colour cinematography, which brings the making of cinematograph pictures in natural colours within the scope of any owner of a 16 mm. cine camera. The new process is marketed under the trade name "Kodachrome".

Processes of colour cinematography may be based either on the additive or the subtractive principle. The former principle involves the addition of primary colours on the screen, or the juxtaposition of small elements of primary colour on the screen: and in the forms in which the process has been exploited commercially for amateur purposes, this juxtaposition of colour elements has been obtained either by means of a cinema film the base of which incorporates a minute mosaic of colour rulings or of a film the base of which is formed with minute, moulded lenticulations working in conjunction with a filter of three-colour strips mounted on the camera lens. Whichever method be adopted, the additive principle is subject to two important objections. First, the pattern of colour elements interferes with the resolution of the image and may easily, in fact, become obtrusive on the screen; secondly, the white highlights, being formed by the addition of primary colours which themselves represent less than one third of the original white light available for projection, must fall seriously below the screen intensity attainable in black-and-white projection.

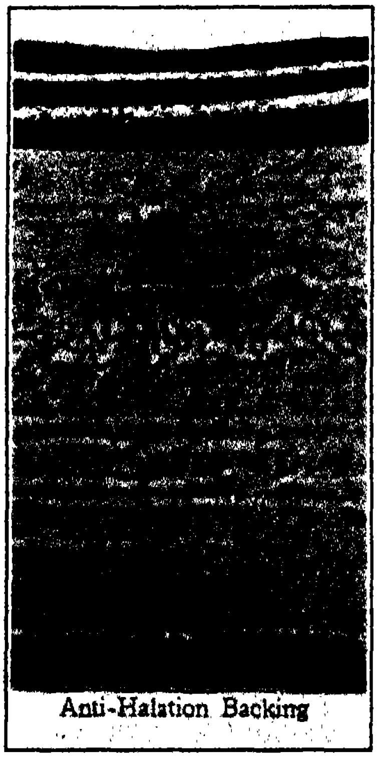



FIG. 1. Section of Kodachrome film. × 500.

In the case of the subtractive principle, of which Kodachrome is the first commercial application in sub-standard cinematography, it is possible to avoid both of these practical shortcomings. In the Kodachrome image there is no form of colour pattern whatever, the colour being present as a dye deposit which is even less granular than a black-and-white film image; and, since the white highlights are represented on the film by clear film areas as free from colour or density as the highlights of a black-and-white film, the screen brilliance is exactly the same as in ordinary cine projection.

The Kodachrome process, moreover, makes colour cinematographic pictures as simple as black-and-white cinematography. In its 16 mm. form, it is a three-colour reversal process, employing a single film which first effects the colour separation automatically during the exposure in the camera and then, on processing, produces the reversed image in natural colours for projection. The colour is present in the body of the processed film in the form of superimposed continuous dye images of almost grainless quality: hence Kodachrome film can be projected with any 16 mm. projector, without special equipment, giving undiminished screen illumination. Definition and resolution are extremely good.

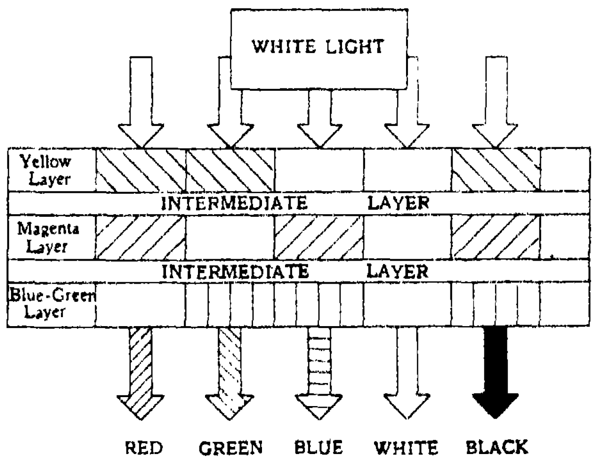



FIG. 2. Scheme for production of primary colours, and of black and white, in finished colour positive.

In picture-taking, the same simplicity is again evident, since Kodachrome film is normally exposed without even a colour filter and with the lens only opened up by one or two stops, compared with Cine-Kodak Panchromatic film. Only for the elimination of haze in distant landscapes is it desirable to make use of a colourless, haze-cutting filter, which does not, however, affect the exposure required. For artificial light work also a correcting filter is required.

The colour separation depends on the fact that the sensitive coating of Kodachrome film, which is scarcely thicker than the single coating of an ordinary film, consists of five exceedingly thin layers—three layers of emulsion with two intervening layers of gelatine (Fig. 1). The total thickness of these five layers is only about 1/1,000 inch. The upper layer is

blue-sensitive and records the blue-component image. The intermediate emulsion layer, to which only green and red rays penetrate, is a green-sensitive emulsion, which therefore records the green-component image. The bottom emulsion, to which only red rays penetrate, is red sensitive and similarly records the red-component image.

In processing, which is effected by a series of continuous machines, the treatment is such as to produce in the three layers of the emulsion positive dye images in the so-called 'minus' colours, the gradations of which represent the distribution of the corresponding primary colours in the subject; namely, a yellow (minus-blue) image in the blue-sensitive layer; a magenta (minus-green) image in the green-sensitive layer; and a blue-green (minus-red) image in the red-sensitive layer (Fig. 2). This production of colour images depends on the use of dye-coupling developers (Fischer, 1912), the action of which is to develop exposed silver halide, forming simultaneously in the film a deposit of dye at the same point as the reduced silver. It has been found possible to discover coupler-developers of this kind which give dye images of the required colours and characteristics.

The first stage of processing is normal development and reversal of the silver image. The reversed film is then re-exposed and completely developed in a blue-green coupler-developer, which reduces the remaining silver halide grains and forms corresponding blue-green deposits in all three layers of emulsion. After drying, the film is then treated with a bleaching solution under such conditions that its action affects only the two upper emulsion layers: in these it bleaches the dye and re-forms silver halide, leaving the blue-green colour in the bottom layer. Then follows a third development, with a magenta coupler-developer, which forms magenta deposits in the two upper layers. After drying again, the film is given a second bleaching treatment which, however, is allowed only to affect the upper layer, leaving the magenta colour in the middle layer. A fourth development, in yellow coupler-developer, leaves the emulsion with dye images of different colour in each layer. In each layer, however, there is silver combined with the dye image and the final treatment is therefore one which removes this silver entirely, leaving the dye images untouched. It is evident that this process lends itself to commercial adaptation to wide fields beyond that of 16 mm. cinematography.

# Main-Line Electrification throughout the World

IN a paper on main-line electrification read to the Institution of Electrical Engineers on April 30, E. R. Kaan, a distinguished Austrian engineer, gave a résumé of recent work done in electrifying railways all over the world.

Electric traction on main lines employs nearly always one or other of two systems. The first is the single-phase alternating current system, the voltage with the contact line being usually 15,000 and the frequency 16⅔. The other is the direct current system, generally at a voltage of 3,000, but when overhead equipment is used it is 1,500. Experts agree that all electric traction problems can be solved equally well from the technical and economic points of view whether A.C. or D.C. is employed; which of these two should be employed depends on local conditions.

Switzerland has done more in electrifying railways than any other European country, only a few branch lines still using steam. The new giant locomotives for the Gotthard line are worthy of mention. The double locomotives are rated at 7,500 and 8,800 h.p. respectively, and are the most powerful in Europe. Each is capable of hauling trains weighing 1,400 tons, brought to them on the level track by two locomotives, up the steep Gotthard slope of 1 in 38 at a speed of 50 miles an hour. Each of these double engines has eight driving axles, and the heaviest express trains can be hauled by one locomotive instead of the two necessary with steam traction. Two can pull the heaviest goods trains, for which three steam locomotives are required.

In Germany, by the end of the year, 1,500 miles of the German Railway Co. will be electrified. Although Germany has very extensive coalfields and lignite at her disposal, it is intended to increase the number of electrified lines. National and political economy are the deciding factors; it is necessary to relieve unemployment and provide work for the highly developed German industry. In southern Germany the energy is obtained from water-power stations which are generally State owned. The single phase A.C. system at 15 kilovolts is used by the company, with the exception of the suburban railways in Berlin, which use D.C.

In Sweden, electric traction has been widely adopted. This is due to the abundance of water-power; the other conditions usually associated with electrification, namely, heavy traffic, steep gradients and unemployment were absent. The water-power stations are chiefly the property of the State. As most of the lines are level, practically only one kind of locomotive, 80 tons in weight, is employed for all types of trains. There are 268 of these locomotives in service. The very satisfactory results obtained are attributed to the high average speed, the fact that a single man can operate an electric locomotive and the considerably lower costs of maintenance.

In Austria, the electrified lines carry 22 per cent of the entire traffic of the Austrian federal railways. In 1914 the Austrians had studied railway electrification. In 1918 the situation became very difficult as the territories to which she was now restricted possessed only lignite. In 1925 it was decided to electrify the whole of the federal railways, and now a great programme has been proposed, comprising the line Salzburg-Vienna, the southern railway as far as Graz, the eastern railway to the Hungarian frontier and the suburban lines of Vienna.

The Hungarian State Railways use the Kando system of electrification, which differs fundamentally from all other systems. It uses three-phase current, which is the standard system of supply and without converting it applies it directly to the traction motors. The generating station is at Banhida, where the furnaces burn inferior earthy coal raised in the vicinity

and not worth transporting. This power station and one of the lines from Budapest were financed by an English loan on condition that a considerable part of the supplies were to be procured from English firms.

In Italy, the Valtelina railway was electrified with three-phase current in 1900, and this introduced the three-phase system into upper Italy. When it was decided to electrify the Bologna-Florence railway, direct current was used. Hence two systems, direct current and three-phase, are used in Italy. The bulk of the necessary electrical energy is obtained from water power stations, two thirds of which are railway owned and one third privately owned.

Mr. Kaan said he hoped that the recommendations of the Weir report for the railway electrification of Great Britain will be carried out, and expressed his great admiration for the way in which the Southern Railway Co. has electrified the London suburban lines and the lines to Brighton, Worthing, Seaford and Hastings.

In France it has been decided to use the grid system of the country to supply the railways. A high-tension grid (60–220 kv.) has been constructed to connect the steam power stations of Paris with the water power stations of the Alps and Pyrenees. In order to afford employment, many lines are scheduled for electrification. It is interesting to notice that some of these are situated in the northern districts of the country, which are rich in coal.

In the United States, not quite one per cent of the 262,500 miles of lines have been electrified. The first long distance line was that connecting Baltimore, Washington and Annapolis. The factors that determined the introduction of electric traction were its greater efficiency in meeting competition and the substitution of water-power for coal.

Mr. Kaan also reviewed the position of electric traction in many other countries and in the British Dominions.

# The *Queen Mary* and Timbers of the Empire

THE latest addition to the Cunard fleet, and one of the largest ships now afloat, the *Queen Mary*, may be truly said to be an Empire ship. The decorations of her interior are largely of wood drawn from the forests of many parts of the Empire—India, the great Dominions and many Colonies.

Teak has long been used in ship construction, and some 1,000 tons of this fine timber has been utilised for decks and gangways, window frames and hand-rails and so forth. More interesting, perhaps, are some of the timbers which have been used in the magnificent panelling which forms so marked a feature of the interior fittings of the great saloons, smoking-rooms, lounges, corridors and state-rooms.

The builders, Messrs. John Brown and Co., Ltd., and their advisers have ransacked the Empire and indeed the world to collect examples of some of the richest timbers so far known to the trade; though this by no means indicates that the trades are yet acquainted with a tithe of the beautiful timbers existing in the moist tropical and mixed deciduous forests of the world. Apart from teak, the following woods amongst others have been used: laurel wood (*Terminalia tomentosa*), India; mahogany (*Swietenia*), British Honduras; cedar mahogany (*Guarea cedrata* or *Thompsonii*), Nigeria and Gold Coast; pommele mahogany (*Entandrophragma* ?), Nigeria; Sapele (*Entandrophragma cylindricum*), British and French West Africa; lemon wood (*Xymalos monospora*), Southern Rhodesia and South Africa (or, *Calycophyllum candidissum*, Cuba); tiger oak, said to be *Machaerium Schomburghii*, Guianas; Macassar ebony (*Diospyros macassar* and *Diospyros* sp.), Celebes; Amboyna (*Pterocarpus* sp.), Moluccas; Makoré (*Mimusops Heckeli*) and Avodiré (*Turreanthus africana*), Ivory Coast; Satinee, or Satiné rubane and Satiné rouge (*Brosimum paraense*), French Guiana (or, Satiné jaune, *Zanthoxylum flavum*, French West Indies); Peroba (*Aspidosperma polyneuron* or *Paratecoma peroba*, syn. *Tecoma peroba*), Brazil; oak nut, possibly nut oak (*Macadamia ternifolia*) and Australian walnut (*Endiandra palmerstonii*), Australia; Oregon myrtle (*Acer macrophyllum*), United States of America; Masur birch (*Betula*), figured birch from Finland, North Russia and elsewhere; grey maple, stained maple and sycamore (*Acer*), and olive ash, figured wood (*Fraxinus excelsior*); walnut (*Juglans regia*) and beech (*Fagus sylvatica*), England and Europe. Also Queensland maple and Canadian (dark) birch.

A study of this great ship would be an education in the products of the forests of the world. The following information kindly furnished by the builders would appear worthy of record on the actual utilisation of some of the above mentioned timbers.

First Class restaurant: Peroba, with feature panels in selected maple burr and Masur birch. Portside aft private saloon, maple burr; starboardside aft private saloon, bleached pommele, feature panel in selected maple burr. Tourist dining saloon, ash burr and grey blistered maple--sideboard, walnut. Forward and aft subsidiary stair and aft corridors promenade deck, figured ash with pillar casings and dado and doors elm burr. Midship entrance promenade deck, figured bleached mahogany with dado and doors in pommele. Two writing rooms, promenade deck, oaknut, chestnut and tables ash burr and straight grained ash and pear. Main hall and promenade deck, same timbers as writing rooms with, in addition, teak. First Class library—a beautiful room—promenade deck, oak burr and sycamore with feature panels in oak burr. Observation lounge and cocktail bar, promenade deck, maple burr with dado and horizontal bandings in cedarmah; counter front and *jardinières* to niche features in finely figured macassar ebony. Corridors, main hall to cocktail bar, promenade deck, maple burr with elm burr dado and doors. First Class children's play room, lemonwood. Sun deck, aft entrance, top and bottom course of walls in straight grained chestnut; centre course and doors in root ash; horizontal bandings in chestnut. Sun deck, forward entrance and sports deck entrance, satinee with doors and dado in elm burr. Long gallery, *Betula* and maple. Starboard gallery, in specially selected laurelwood. First Class smoke room—another very beautiful room—English oak

burr, walnut and tiger oak. First Class lounge, selected maple burr with dado in makoré, walnut skirting and high and low level soffits in Masur birch. Aft and forward staircases, figured ash, dado in elm burr. Main staircase, figured ash. Dado in elm burr with feature panel on promenade deck of specially selected and cut peacock walnut burr, graded to outer sides with special elm burr. It is said that this log was specially cut for the *Queen Mary*. First Class ballroom, skirting and dado in specially cut logs of Makoré with small marquetry banding in the Makoré doors of maple burr; remainder of the room painted. First Class entrance foyers on main and *B* deck, dado in elm burr, with filling above in chestnut, banded. First Class, *A* and *C* decks, elm burr dado with masur birch filling banded horizontally with straight grained birch. Much of the beautiful furniture in the ship is made of Honduras and other mahogany, oak, French walnut and Austrian beech.

It is due to the modern use of veneers and plywood that the decoration of this vast ship in so artistic a manner has become possible. A study of the *Queen Mary* will be a revelation to many of the great progress which has been achieved in this direction.

## Educational Topics and Events

CAMBRIDGE.—M. T. Greig has been appointed University demonstrator in anatomy.

The Gordon Wigan Prize in chemistry has been awarded to W. C. G. Baldwin, of Christ's College, for a dissertation entitled "Phenomena associated with Optically Active Absorption Bands".

The Managers of the Balfour Fund propose to consider the appointment of a student as from October 1, 1936. The studentship is of the annual value of £300 and the appointment is for three years. Applicants need not be members of the University of Cambridge. Further information can be obtained from Prof. J. S. Gardiner, Zoological Laboratory, Cambridge, before May 31.

At Clare College, Dr. H. M. T. Taylor, University lecturer in the Faculty of Mathematics, has been elected into an official fellowship.

OXFORD.—During the visit of the British Medical Association in July, honorary degrees of D.Sc. will be conferred on Sir George Newman, Sir Cuthbert Wallace, Sir Henry Dale, Sir Walter Langdon-Brown, Dr. Robert Hutchison and Prof. Charles Singer.

H. O. Newboult and R. Opie, fellows of Magdalen College, have been appointed University lecturers in mathematics and economic science respectively. Dr. B. D. Pullinger has been appointed University lecturer and demonstrator in pathology from October 1, and Dr. S. Zuckerman University lecturer and demonstrator in human anatomy from April 1, 1937.

Balliol College proposes to elect a Skynner senior student in astronomy this term. The studentship is of the value of £200 a year and may be held for two years.

Christ Church proposes to elect this term at least one 'lecturer' and one senior scholar to carry out research in science or literature. The lectureship is worth £300 a year for five years and the scholarship £200 a year for two or four years.

The subject of the course of eight lectures given this term by the Wilde lecturer in natural and comparative religion, Dr. F. L. Cross, is "Religion and Scientific Thought from the Renaissance to Leibniz".

THE mechanisation of university studies is attacked by Dr. W. S. Learned, of the Carnegie Foundation for the Advancement of Teaching, in a recently published report on the progress of the Foundation's elaborate inquiry, begun eight years ago, into the relation of secondary and higher education in Pennsylvania. The chief instrument employed in this inquiry has been an extensive series of tests covering the main aspects of general education and designed to measure the sum total of the student's acquired skills and store of serviceable knowledge—the intellectual fixed capital available for future use. The tests are said to "constitute a searching and comprehensive probe such as has never been available hitherto", and made possible comparisons of ratings of students of different academic grades and of the same student at different stages. The results expose the weaknesses of a system of grouping students according to the extent of the formal academic 'courses' they have completed. Thus: in an examination of eleven thousand students belonging to three academic groups, (*a*) high school final year, (*b*) college second year, and (*c*) college fourth year, 22 per cent of (*a*) were ranked higher and 29 per cent of (*c*) lower than the average of (*b*), while 10 per cent of (*a*) did better than the average of (*c*), and vice versa. Again, in a typical college, 34 undergraduates at the end of their first year scored higher than 72 per cent of seniors on the eve of graduation. Two years later, when the entire college was re-examined with the same test, two-thirds of these brilliant freshmen had actually lost ground. "Although as freshmen they were already beyond that intellectual level at which the college could serve them effectively, they were obliged to mark time for three more years until the calendar should release them".

## Science News a Century Ago

### The Dudley and Wolverhampton Coalfield

AT a meeting of the Geological Society held on May 11, 1836, Lyell being in the chair, Murchison read a paper "On the Dudley and Wolverhampton Coalfield, and on the Formations connected with it, followed by a Description of the Lickey Quartz Rock". This was one of a series of papers in which Murchison described the structure of the border counties of England and Wales and the southern part of the Principality. The great coalfield of Dudley and Wolverhampton, the most productive in the central part of England, he said, is geologically distinguished by the total absence of the mountain limestone and the old red sandstone, which form the fundamental rocks of so many of the coal tracks of Great Britain. The formations which constitute the sub-strata of the district are known only by their irregular protrusion through the coal measures near Sedgeley and Dudley, and through the new red sandstone at Walsall, or by having been reached in some of the deepest pits. These

rocks belong to the system to which Murchison gave the name Silurian, and compose the greater part of the border counties, with Carmarthenshire and Pembrokeshire.

### Encouragement to Literature and Science in France

UNDER the above heading, the *Athenæum* of May 14, 1836, printed the following remarks: "The sum of £130,000 is annually devoted to this purpose by our enlightened neighbours, and is distributed among the Institute of France, the Royal College, the Museum of Natural History, the Board of Longitude, the Royal Library, the Museum of the Louvre, etc.; including an allowance for the encouragement of the dramatic art; for the publication of travels of French *Savants*; for pensions to 90 literary men and artists; and for some other objects. To our own executive we would say 'Go thou, and do likewise'."

### Hancock and his Steam Carriages

ON May 14, 1836, the *Mechanics' Magazine* said: "Mr. W. Hancock whose perseverance deserves success, commenced running his steam carriages, the 'Enterprise' and 'Erin' on Wednesday morning last, at nine o'clock, from the Station in the City-road to London Wall; from thence he proceeded to Paddington and returned to the city. On the first day he performed three of these journeys, on the second, four, and on the third (yesterday) two, before noon. The average time of travelling over the ground has been 1 hour and 10 minutes including stoppages to take in passengers, water and coke. This is just half the time the horse-omnibuses take in going over the same ground. In the 9 journeys performed, the number of passengers carried was 220, averaging about 12 persons each trip. Mr. Hancock intends to run his carriages regularly the same number of journeys daily, for the present, and very shortly to increase the number."

### Baily and the Solar Eclipse of May 15, 1836

THE annular solar eclipse of May 15, 1836, will always be remembered for the observation by Francis Baily (1774–1844) of the phenomenon to which the name of 'Baily's beads' was given. Baily observed the eclipse at the house of his friend Veitch at Inch Bonney near Jedburgh. "When the cusps of the sun," he wrote, "were about 40° asunder, a row of lucid points, like a string of bright beads, irregular in size and distance from each other, *suddenly* formed round that part of the circumference of the moon that was about to enter, or which might be considered as having just entered on the sun's disc. Its formation indeed was so rapid that it presented the appearance of having been caused by the ignition of a fine train of gunpowder. . . . Finally, as the moon pursued her course, the dark intervening spaces (which, at their origin, had the appearance of lunar mountains in high relief, and which still continued attached to the sun's border) were stretched out into long, black, thick, parallel lines, joining the limbs of the sun and moon; when all at once they *suddenly* gave way, and left the circumference of the sun and moon in these points, as in the rest, comparatively smooth and circular, and the moon perceptibly advanced on the face of the sun." (*Mem. Roy. Ast. Soc.*, 10, 5–6.)

## Societies and Academies

### PARIS

Academy of Sciences, March 30 (*C.R.*, **202**, 1125–1224). ELIE CARTAN: Fields of uniform acceleration in limited relativity. MARCEL GODCHOT, MLLE. GERMAINE CAUQUIL and RAYMOND CALAS: The application of the Raman effect to the study of some methylcyclopentane derivatives. The principal lines of the methylcyclopentane nucleus already described appear in all the derivatives studied. The spectra of the active and racemic compounds may be regarded as identical. JEAN BOSLER was elected *Correspondant* for the Section of Astronomy in succession to the late Willem de Sitter. HERMAN WOLD: Surfaces of mortality. DIMITRI PEREPELKINE: Certain orthogonal varieties in $R_n$. ALEXANDRE OSTROWSKI: The transformation of the folds in conformal transformation in the neighbourhood of a frontier point. STEFAN KEMPISTY: The area of the surface $z=f(x, y)$. ARNAUD DENJOY: Physics and metrics of ensembles. Remarks on a note of Paul Lévy. RENÉ HARMEGNIES: Some properties of networks. A. KOLMOGOROFF: The Betti groups of locally bicompact spaces. ANDRÉ WEIL: Topological groups and measured groups. M. KELDYSCH and M. LAVRENTIEFF: Suites of harmonic polynomials. GEORGES BOURDELLE: The approximation given by certain transmission dynamometers, energy integrators. MAURICE LUCAS: Constraints imposed by contraction on a body included in a mass of cement. The study in a plane. VALENTIN V. VEDERNIKOV: The solution of the problem in two dimensions of the stationary current of underground waters with free surface. MLLE. MARIE ANTOINETTE BAUDOT: Remarks on a form of a function of action. ARKADIUS PIÉKARA and MAURICE SCHÉRER: Correction to a note on the magnetic change of the dielectric constant of liquids. The data published in an earlier note (*C.R.*, **201**, 335) have been found to be in error. THÉODORE V. IONESCU and CONSTANTIN MIHUL: The distribution of the velocities of the electrons in the magnetic field. ROBERT BOSSUET: Alkaline metals in natural waters. A list of springs in which all five alkali metals have been detected, with a second list of springs containing all alkali metals except cæsium. RENÉ LUCAS: The diffraction of light by ultrasound waves. Discussion of the theory of Raman and Nagendra Nath and description of experiments showing the limitations of this theory. PAUL SOLEILLET: Applications of the theory of the coherence of vibrations. LADISLAS GOLDSTEIN and MARCEL LECOIN: The continuous $\beta$-spectrum of RaC″. WILFRIED HELLER, OTTO KRATKY and HANS NOWOTNY: The constitution of the iron oxide sols. The results of the application of magneto-optic and X-ray methods. HENRY PARISELLE: Contribution to the study of the complex lead compounds of the oxyacids. Polarimetric study of the reaction between lead nitrate and tartaric acid. MARCEL PRETTRE: The laws governing the initial acceleration of slow combustion and the delay of spontaneous inflammation of mixtures of normal pentane and oxygen. Application to the phenomena of 'knocking' in motors. ANDRÉ KLING, MAURICE ROUILLY and MAURICE CLARAZ: A simple method for estimating the proportion of carbon monoxide in an atmosphere. VICTOR AUGER: The molybdenum blues. GUY GIRE: The hydrolysis of basic nickel sulphate. CLÉMENT

DUVAL: The constitution of the organomagnesium compounds. The results of the electrolytic experiments described confirm the formula of Jolibois. MLLE. YVONNE GARREAU: The oxidation of hydroquinone and of chlorhydroquinone in the presence of ammonium sulphite. The oxidation of a hydroquinone disulphonate in the presence of ammonia. LÉON ENDERLIN: Contribution to the study of the reversible oxidisability of organic compounds: the dihydroxide of bis-*p*-bromophenyl-diphenylrubene. MARCEL FRÈREJACQUE: Controlled hydrolysis of the acetyl derivatives of the reducing sugars. PAUL GAUBERT: The modifications of the facies of uric acid crystals by colouring matters added to the mother liquor. FRANCIS BARILLET: The effect of β-naphthalene sulphonic acid on the crystallisation of copper sulphate pentahydrate. ALFRED SILBERSTEIN: The structure of the double bromide of copper and ammonium. F. BLONDEL and J. BONDON: Remarks on the distribution of the principal mineralisations of Morocco. PIERRE COMTE: The middle and upper Devonian of Léon (Spain). ARMAND RENIER: The appearance of an inflection towards the overlap of the Varisc strata by the Armorican strata in the Franco-Belgian coal basin. ALBERT MICHEL-LÉVY: The presence of mylonites in a Visean conglomerate to the south of Tarare and the interpretation of the old strata in the Monts du Lyonnais. GEORGES ATHANASSOPOULOS: The rise to the surface of Civelles. RAYMOND HOVASSE: Experimental duplications of the anterior parts of tadpoles in *Rana temporaria*. MLLE. ANNE MARIE COLLOT and JACQUES RABATÉ: The presence of *d*-catechol in the bark of the peach tree. ERNEST KAHANE and MLLE. JEANNE LÉVY: The presence in normal blood of an acetylcholinic substance in a concealed state. MLLE. IRÈNE KOPACZEWSKA, W. KOPACZEWSKI and STANISLAS MARCZEWSKI: The spontaneous reversibility of the seric gel formation. CONSTANTIN LEVADITI and PAUL HABER: The evolution of the virus of bird plague in the hepatic cells of mice. ALEXANDRE BESREDKA and LUDWIK GROSS: Vaccination of the rabbit against subcutaneous epithelioma. Intracutaneous inoculation of epithelioma immunises the rabbit against the malignant subcutaneous tumour: the immunity is specific and lasting. LÉON BINET and J. MAREK: Hypoglycæmia in the course of poisoning by the fungus *Amanita phalloides*. FREDERICO NITTI and DANIEL BOVET: Experimental streptococcic septicæmias and their treatment by *p*-aminophenylsulphamide.

### GENEVA

Society of Physics and Natural History, March 5. ARNOLD PICTET: The action of a lethal factor in the descent of an interspecific crossing of guinea pigs. CH. G. BOISSONNAS: The influence of the molecular weight on the activity of solutions. P. BALAVOINE: The presence of manganese in tea. D. ZIMMET and H. DUBOIS-FERRIÈRE: The sensibility and the stability of the nickel nitroprusside reaction for reduced glutathione. D. ZIMMET, B. GHINSBERG and L. JANCU: The influence of padutine (callicreine) on the growth and morphogenesis of the tadpoles of *Rana temporaria*.

March 19. M. GYSIN: The origin of a crystalline schist of southern Katanga. The author has studied a chlorito-epidotic felspathic schist containing biotite arising from southern Katanga. He attributes the formation of this schist to the metamorphism of a gabbro rock. To confirm this point of view, he has determined on a Shand stage the quantitative mineral composition of the crystalline schist and has hence deduced the chemical composition. He shows that this composition agrees closely with that of various Swiss gabbro rocks. TH. HILLER: The identification of silver in opaque minerals by the imprint method. CH. CIMERMANN, D. FRANK and P. WENGER: The micro-estimation of zinc by means of oxyquinoline.

### MOSCOW

Academy of Sciences (*C.R.*, 1, No. 2, 1936). A. S. BAKALIAJEV: The theorem of unity in the case of some problems of limits in the elasticity theory. M. KREIN: Positive Green functions in Mercer's sense. N. MOISSEJEV: (1) On some anepicyclic regions in the limited problem of three bodies. (2) A simplified scheme of the planetary system. S. SCHUBIN and A. SMIRNOV: A simple example from Born's electrodynamics. M. VUKS: Modified dispersed radiation from crystals, and movements of molecules of a grid. K. S. TOPCHIEV: Symmetrical di-[α-α′-picolyl]-thiourea. N. NAZAROV: Dehydration of methyl-di-tertiary butyl-carbinol. Splitting and isomerisation of di-tertiary butyl-ethylene. I. B. PANSHIN: A demonstration of the specific nature of position effect. H. J. MULLER, A. A. PROKOFJEVA-BELGOVSKAJA and K. V. KOSSIKOV: Unequal crossing-over in the bar mutant as a result of duplication of a minute chromosome section. M. A. CAJLACHJAN: Mechanism of photo-periodic reaction. F. W. SHATILOV: Stimulation of the development of plants and of the ripening of fruits on them by means of ethyl alcohol and temporary anaerobiosis of the root system. P. J. SCHMIDT: The genera *Davidojordania*, Popov and *Bilabria*, gen. nov. (Pisces, Zoarcidæ).

### VIENNA

Academy of Sciences, March 12. ERNST SPÄTH, LEOPOLD SCHMID, and HEINZ STERNBERG: Rhœadine and rhœaginine. Rhœadine has the formula $C_{21}H_{21}O_6N$ and contains a methoxyl group, while rhœaginine lacks the methoxyl group and has the formula $C_{20}H_{19}O_6N$. The oxidation, reduction and Hofmann reaction of rhœaginine are described. H. WIESENEDER: Discovery of amphibolite eclogites in the Niederen Tauern. JOHANNA WIESTHAL: Effect of irradiation with radon on different kinds of glass. The solubility of glass in water is increased by irradiation. DORA BUCHGRABER: Estimation of radium and radon solutions. ALOIS KIESLINGER: Geology of the south-east Bacher. OTHMAR KÜHN: A new Burdigalian formation at Horn. FRANZ HERITSCH: (1) Diluvium and late Tertiary near the Faaker See in Carinthia. The Vinza breccia near Faak is ascribed to detritus from the late Tertiary of the Karawankas. (2) The north side of the Karawankas in the Worunizagraben—Faak-am-See—Kanzianiberg region. EMIL WORSCH: Geological survey east of the Faaker See. OTTO DISCHENDORFER and AUGUST VERDINO: Condensation of benzoin and thymohydroquinone. E. HAYEK: Complex chemical behaviour of silver fluoride.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Monday, May 11

UNIVERSITY OF CAMBRIDGE (Cavendish Laboratory), at 4.30.—Prof. E. V. Appleton, F.R.S.: "The State of the Upper Atmosphere" (Scott Lectures. Succeeding lectures on May 13, 15 and 18).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—M. Spender: "Photographic Surveys in the Mount Everest Region".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. F. M. Jaeger: "Researches on the Specific Heats of Metals and their Alloys at High Temperatures".*

### Tuesday, May 12

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Dr. J. E. McCartney: "The Control of Diphtheria in Hospital Wards".

COLLEGE OF THE PHARMACEUTICAL SOCIETY, at 5.30.—Prof. Arthur Stoll: "Cardiac Glucosides" (succeeding lectures on May 13 and 14).*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting.

ILLUMINATING ENGINEERING SOCIETY, at 7.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Annual Meeting.

Dr. Morry Cohu: "Progress in Illumination in France".

### Wednesday, May 13

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP, at 2.30)—Annual General Meeting.

Prof. E. Waldschmidt-Leitz: "Recent Developments in Enzyme Chemistry".

ROYAL SOCIETY OF ARTS, at 8.—Prof. R. G. Stapledon: "The Case for Land Improvement and Reclamation".

### Thursday, May 14

UNION OF MODERN FREE CHURCHMEN, at 2.45.—(in the Library, Memorial Hall, Farringdon Street, E.C.).—Dr. Alexander Wood: "The New Physics and its Implications".*

ROYAL SOCIETY, at 4.30.—Discussion on "The Present Status of the Theory of Natural Selection", to be opened by Prof. D. M. S. Watson, F.R.S.

LONDON MATHEMATICAL SOCIETY, at 5.—(at the Royal Astronomical Society, Burlington House, W.1.)—Dr. A. C. Aitken: "Arithmetical Recreations".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Gerhard Bersu: "Roman Limes in Germany" (succeeding lectures on May 18 and 21).*

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Prof. F. A. Vening Meinesz: "The Gravity Results of the Undersea and Oversea Journey of the Submarine *K XVIII* in the Atlantic and Indian Oceans".*

CHEMICAL SOCIETY, at 8.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Dr. Clarence Smith: "Modern Chemical Nomenclature".

BRITISH INSTITUTE OF RADIOLOGY, at 8.—Annual General Meeting.

### Friday, May 15

KING'S COLLEGE, LONDON, at 5.—Prof. Henri Fredericq: "The Laws of Excitation of the Autonomic Nervous Systems with reference to Chemical Mediators".*

BATTERSEA POLYTECHNIC, at 7.—Prof. F. C. Lea: "The Effect of Temperature on the Strength of Metals" (Lectures arranged by the Armourers and Brasiers' Company. Succeeding lectures on May 22 and 29).*

ROYAL INSTITUTION, at 9.—Sir Richard Gregory, Bt., F.R.S.: "Science in a Changing World: Recollections and Reflections".

## Official Publications Received

### Great Britain and Ireland

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry. (Published for the Association of British Chemical Manufacturers.) *Supplement* No. 5. Pp. 6. (Cambridge: W. Heffer and Sons, Ltd.) 6*d*. [34

B B C Annual, 1936. Pp. 160. (London: British Broadcasting Corporation.) 2*s*. 6*d*. net. [84

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1935, presented to the Annual Meeting, February 10th, 1936. Pp. 51+6+4 plates. (York: Yorkshire Museum.) [94

Research Association of British Rubber Manufacturers. Sixteenth Annual Report for the Year 1935. Pp. 61+2 plates. (Croydon: Research Association of British Rubber Manufacturers). [144

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 26: The Geology of Inchkeith. By Lieut.-Col. L. M. Davies. Pp. 753–786+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 5*s*. 6*d*. [144

Agricultural Progress: the Journal of the Agricultural Education Association. Vol. 13, 1936. Pp. 190. (Cambridge: W. Heffer and Sons, Ltd.) 5*s*. net. [144

The Functions of an International Air Police. (Series F, No. 2.) Pp. 20. (London: The New Commonwealth.) 6*d*. [144

### Other Countries

Rensselaer Polytechnic Institute Bulletin. Vol. 34, Extra to No. 4: The Future of Engineering Education. By Dr. William Otis Hotchkiss. Pp. 12. (Troy, N.Y.: Rensselaer Polytechnic Institute.) [74

Institut de France: Académie des Sciences. Annuaire pour 1936. Pp. 407. (Paris: *Gauthier-Villars*.) [94

Kungl. Sjökarteverket. Jordmagnetiska Publikationer Nr. 10: Earth Magnetic Researches along the Coasts of Sweden. Part 1: Magnetic Declination at the Epoch, July 1, 1929. By Gustaf S. Ljungdahl. Pp. 48+6 plates. (Stockholm: Kungl. Sjökarteverket.) [94

India Meteorological Department. Meteorological Organisation for Airmen. (M.O.A. Pamphlet, 1936.) Pp. iv+51. (Delhi: Manager of Publications.) 1.2 rupees; 2*s*. [144

Old-Time Survivals in South Africa. By Eric Rosenthal. Pp. 38. (Pretoria: Government Printer.) [144

A Shellac Patent Index. By Dr. R. W. Aldis. Pp. vi+115. (Nankum: Indian Lac Research Institute.) 2.8 rupees. [144

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 135: JS-Diagrams for Air. By Seiichi Awano. Pp. 81–104+11 plates. 1.90 yen. No. 136: The Nature of the Torsion-Aileron Flutter of a Wing as revealed by Analytical Experiments. By Katsutada Sezawa and Kei Kubo. Pp. 105–161+3 plates. 55 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [144

Transactions of the National Institute of Sciences of India. Vol. 1, No. 7: A Study of some Microscopical Aspects of Indian Manganese-Ores. By Dr. J. A. Dunn. Pp. 103–124+plates 4–6. (Calcutta: National Institute of Sciences of India.) 3 rupees. [144

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series, Bulletin No. 21: Biological Control of the Sugar Cane Leafhopper in Hawaii. By O. H. Swezy. Pp. ii+57–101. (Honolulu: Hawaiian Sugar Planters' Association.) [144

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Studies in Neotropical Mallophaga. Part 1: Lice of the Tinamous. By M. A. Carriker, Jr. Pp. 45–218. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [144

Elihu Root Lectures of Carnegie Institution of Washington on the *Influence of Science and Research on Current Thought*. *The History* of Science and the Problems of To-day. By George Sarton. (Supplementary Publication No. 20.) Pp. iii+30. (Washington, D.C.: Carnegie Institution.) [144

The Hokkaido Imperial University. Calendar 1935–1936. Pp. iv+228. (Sapporo: Hokkaido Imperial University.) [144

Pocket Natural History No. 5: Florida Fishes. By Harold L. Madison. (Zoological Series No. 2.) Pp. 32. (Cleveland, Ohio: Cleveland Museum of Natural History.) 25 cents. [154

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 14: On a Pair of Surfaces Mutually Related, 2. By Sôji Matsumura. Pp. 307–340. (Taihoku: Taihoku Imperial University.) [174

National Research Council of Canada. Bulletin No. 16: Health Hazards in the Radium Industry. By John D. Leitch. Pp. 19. Bulletin No. 17: Radium Dosage. By G. C. Laurence. Pp. 50. (Ottawa: National Research Council of Canada.) [204

U.S. Department of the Interior: Geological Survey. Bulletin 869: Bibliography of North American Geology, 1933 and 1934. By Emma M. Thom. Pp. ii+380. 40 cents. Water-Supply Paper 763: Surface Water Supply of the United States, 1934. Part 8: Western Gulf of Mexico Basins. Pp. vi+188. 20 cents. Water-Supply Paper 766: Surface Water Supply of the United States, 1934. Part 11: Pacific Slope Basins in California. Pp. xi+364. 45 cents. Water-Supply Paper 768: Surface Water Supply of the United States, 1934. Part 12: North Pacific Slope Basins. B: Snake River Basin. Pp. vii+202. 25 cents. (Washington, D.C.: Government Printing Office.) [204

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1934. Pp. ii+60. (Jamaica: Government Printing Office.) [204

### Catalogues

Philips Technical Review. Vol. 1, No. 1, January. Pp. 32. Vol. 1, No. 2, February. Pp. 33–64. (*London: Philips Lamps, Ltd.*)

New Oxford Books: a List for Secondary Schools. Pp. xxxii. (London: Oxford University Press.)

The Right Way to Choose your House. No. 1: Facts you should Know. Pp. 16. (London: Clay Products Technical Bureau of Great Britain.)

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# A Bureau of Human Heredity

IT is a remarkable fact and a no less striking example of the vicissitudes in human affairs that one branch of research, the modern study of genetics, in which the results are put to the test of practical application with the least delay, should spring from an investigation which was forgotten, and of which the record lay hidden in an obscure publication for fifty years. The resurrection of Mendel's paper on heredity, and the rapid and widespread effects which have followed the application of its principles to further experiment and to practical uses, drive home the lesson of the need for co-operation and co-ordination in scientific investigation as a condition of further advance and the avoidance of wasted effort.

The study of the principles of heredity in their application to cattle-breeding and the improvement of the food-supply, as, for example, in producing types of wheat suitable for the requirements of varying soil, climate and purpose, has tended by the immediate availability of results for the advantage of human society, to absorb the practical interest of the public. This has ensured the continued pursuit of the researches upon which such results are based.

It has at times been objected that too little is known of the facts of human inheritance for it to be at present of more than academic interest, while the time is not yet ripe to make its study of practical effect in every-day problems. This, however, if true, is true only in part; and while indeed there are vast fields of research which await exploring, there is also a mass of information, which even in the interest of purely scientific investigation, stands in need of centralisation and co-ordination, and through such centralisation might be made available for far-reaching application.

The need for some such organisation of the data bearing upon human heredity has long been felt. So long ago as 1930 it received practical recognition in the appointment by the International Federation of Eugenic Organisations of an International Human Heredity Committee, of which the main purpose was the setting up of a clearing house for human heredity. The purpose of the clearing house was then laid down to be the collection and analysis of material, the distribution of the information thus digested to institutions, to answer inquiries, and to provide assistance for research workers, as well as prepare bibliographies of current literature.

After prolonged inquiry, the International Bureau approached the British National Committee, which had been instituted in affiliation with the international body, and suggested that London was the most suitable centre for such a Bureau. In accordance with this suggestion, the British Committee in 1933 undertook to set up a Bureau of Human Heredity, which now, it is announced, has its quarters at 115 Gower Street, London, W.C.1. This Bureau will co-operate as fully as possible with other organisations working on cognate material, with the view of economising effort and avoiding overlap; but it will not be otherwise, or more closely, connected with any other organisation. Its management will be in the hands of a Council, which in the first instance will be constituted by members of the existing National Committee, to whom will be added from time to time representatives of medical and scientific bodies, whose co-operation is desired. It should thus be possible to cover as wide a field as is possible among those who are either engaged in research or in the application of its results to

practical ends. Thus among the members of the first Council are members of the Genetics Committee of the Medical Research Council and the Industrial Research Board, Prof. R. A. Fisher, director of the Galton Laboratory, Prof. Cyril Burt, representing psychology, and Prof. F. A. E. Crew, of Edinburgh. Prof. R. Ruggles Gates will act as chairman, Sir Laurence Halsey as honorary treasurer, and Mrs. C. B. S. Hodson as honorary secretary. To these are to be added representatives of the Royal Society of Medicine, the Statistical Society, the Medico-Psychological Association, the Eugenics Society, and the British Medical Association. In view of the consideration that the value of the Bureau as a place of reference for facts to medical men and other inquirers has been strongly stressed, it may be suggested that the representation of pure biology upon the Council stands in need of enlargement.

Lastly, on the important matter of finance. The Bureau at present depends entirely upon private subvention. It is estimated that now that some small sums have made it possible to set the Bureau at work, £10,000 is required to keep it going for a period of five years, and an appeal for this amount has appeared in *The Times* of May 6 over the signatures of Prof. R. Ruggles Gates, Sir F. Gowland Hopkins, Lord Moynihan, Sir Arthur Keith, Sir Grafton Elliot-Smith and others. The purpose of the appeal is one which may heartily be commended to the generosity of all who are interested in scientific studies of man.

# The Key Industries Act

THE Key Industries Act may be termed appropriately the 'Fine Chemists' Charter' for, under its shelter, there has been built up in Great Britain a vigorous manufacturing industry giving employment to a number of chemists and chemical workers, which is to-day in a position to supply all the essential requirements in medicinals and fine chemicals needed by the British Empire, and is year by year adding products to its list.

It is a matter of history that the Act was first imposed as from October 1, 1921, with the object of protecting the manufacture in Great Britain of a number of substances and of scientific apparatus, which were essential for defence purposes, from unfair competition, particularly as many of the industries had arisen under war conditions and had been given no time to reorganise on a peace basis. The danger of the potential deficiencies in these industries was a serious one, and it was widely recognised that the words 'key industries' and 'safeguarding' had a very real significance.

The Key Industry Duties were extended and amended in 1926, and became due to expire in August 1936. They have now been extended in the Budget for a further period of ten years, following the report to this end of a committee set up by the Import Duties Advisory Board, which has made a searching study of the question. A useful survey of the working of the Act appears in the April issue of the *Industrial Chemist*.

There has been some suggestion that the Act should be allowed to lapse and the products transferred to the Import Duties Act, but cogent arguments were produced against the change, particularly because it involved a change in the administrative machinery which has been worked so efficiently by the Board of Trade during the fifteen years of 'safeguarding'. It will be possible in the future, however, to impose extra duties beyond the 33⅓ per cent *ad valorem* on individual substances coming under 'safeguarding' if the Import Duties Advisory Committee so determines.

It is, of course, known that the Act covers optical and scientific glass, porcelain and scientific instruments, gauges and certain other materials besides chemicals. These latter are defined as "all synthetic fine chemicals", "analytical reagents, all other fine chemicals", and from time to time inquiries before a tribunal have been held to decide whether certain substances came within this definition. In December 1933 a "preparation", as distinct from a chemically identifiable compound, was added to the list against the opposition of the Board of Trade, a decision which did not find favour in medical circles.

It is unquestionable that the fine chemical industry of Great Britain, and indeed the chemical industry as a whole, has benefited greatly from the imposition of the duties. Its continuance will give a reasonable period of security in which long-term plans can be undertaken, and research and the training of the necessary staff encouraged.

# Organisation of Science in the U.S.S.R.

**Soviet Science**
By J. G. Crowther. Pp. x+342+16 plates. (London: Kegan Paul and Co., Ltd., 1936.) 12*s*. 6*d*. net.

MR. CROWTHER is well qualified for the task he has undertaken. He has already published two books on historical aspects of science, and he has a wide knowledge of Russian scientific institutions. Further, he is very friendly disposed to the Soviet system, presenting everything in the most favourable light, yet never distorting facts or indulging in propaganda. He gives in this book the most complete account yet issued in English of the present position in the different branches of science in Russia.

The author shows at once his familiarity with his subject by starting with an account of dialectical materialism. This is the philosophy underlying modern Russian developments in politics, science and art, and without some knowledge of it one cannot properly appreciate and understand science as pursued in Russia to-day. In the first ten pages the author gives a well-written summary of this method of proceeding by thesis, antithesis and synthesis, but it would have been useful to give reference to accounts by English philosophers as well as those of Bukharin and Lenin. Those English men of science who wish to enter fully into the spirit of Russian science must first familiarise themselves with this system of philosophy, otherwise they will constantly find themselves confronted with ideas they completely fail to understand.

Next follows an account of the organisation of scientific activity in Russia. The Academy of Sciences is at the head: its original restriction to forty members has been relaxed, and it now includes 18 chemists, 13 historians, 10 philologists, 10 geologists, 8 orientalists, 8 biologists, 8 engineers, 6 economists, 4 physicists and 2 philosophers. The sciences are divided into three departments, natural science, sociology and technology; these are pursued in about twenty large institutes with great staffs and a considerable budget.

The Academy makes its five-year plan of scientific investigation which the Institutes then carry out. The individuals working at these institutes may discuss among themselves how best to perform their allotted tasks, but they cannot strike out a line of their own independent of the Academy's instructions. Until 1934 the Academy was in Leningrad, but it was felt that the intellectual atmosphere of that city was not assimilated to that of the new communist society; the Academy was therefore transferred to Moscow, in the hope that, as Mr. Crowther says, "if the intellectual centre was also at the headquarters of the Government and nearer to the spiritual sources of the new ideology, the defects in its intellectual atmosphere would be removed by the closer contact".

The work of several of the institutes is described. The organisation is completely different from anything in Great Britain. There are frequently three leaders; the director, the secretary of the trades union to which the members of the staff belong, and the secretary of the group of Communists or the 'party cell' in the laboratory. The Communists (called simply 'the Party') are not numerically strong; Mr. Crowther instances an Institute where out of 330 members of staff only 34 are members or candidates for membership of the Party. But their power is such that no director dare go against their wishes. Competition for the directorship is not so severe as in Great Britain. In the newer buildings the scientific staff live in flats at the Institute, so that they are available to each other at all times; at Kharkov, for example, each flat may have three rooms, electric light and gas for a cooker. There are some disadvantages; water is often scarce and household washing and baths may be possible only at night. As everywhere, the staff are young, mostly less than thirty, none more than forty-one years of age. Frequently the workers engaged on a particular problem are organised in a brigade which holds meetings and adopts other devices to foster the collective spirit and to carry out their allotted duties according to plan. The different brigades enter into "socialistic competitions" with each other to see which can do the best work, or the quickest work. "The personal desires of the individual members of a brigade," says Mr. Crowther, "receive little consideration." Behind all stands the 'party cell' to explain Stalin's pronouncements, to organise socialistic competitions, and generally to see that the 'plan' is carried out. Staff lectures and staff meetings are frequent, and much stress is laid on the need for political and philosophical instruction of the staff: "discussion of philosophical questions," Mr. Crowther tells us, "deepens the workers' understanding of the nature of science and its role in social affairs. It reveals, too, often unconsciously, the tendencies of the participators'

thoughts. Saboteurs may be discovered through the suggestiveness of their philosophical opinions." Mr. Crowther does not say what becomes of these saboteurs, and indeed he may not have been able to find out.

The numbers of people engaged are enormous. Mr. Crowther describes, among others, N. I. Vavilov's Plant Research Institute at Leningrad, now being transferred to Moscow. One branch alone of his work requires 1,800 assistants; another requires 2,000. Huge staffs of this sort present no difficulty to Vavilov, who is certainly one of the most remarkable men I ever met in Russia. He began by making botanical expeditions to various parts of the world to collect the wild species of the various cultivated plants, and set up the very interesting hypothesis that a region where many wild varieties of a species occur is clearly a region of genetical instability and therefore probably a centre of origin of that species. On this basis he has constructed maps showing where the various species of cultivated crops arose. These he finds are very similar to the maps showing the origin of domesticated animals and of civilised man. He uses this enormous mass of material in making genetical experiments on a grand scale, and already he has produced some very interesting new varieties of crops.

It is almost like a different world from ours. Which will in the end prove the better method for scientific discovery? The British system has its defects, which the dialectical materialists are not slow to point out; Mr. Crowther quotes as one of their paradoxes: "as scientists [in Western conditions] achieve more and more extraordinary triumphs in their own branches they seem as a class to become more and more stupid". In this new system of planned scientific activity "every scientist knows his place and the degree of his dependence on others. He is unable to give harmful expression to illusory ideas of absolute freedom or behave with social irresponsibility".

We know how much the world already owes to Russian scientific genius. Will the new order help it? How much freedom is necessary for human development? Perhaps the most interesting and valuable part of the great Russian experiment is that it will show how far a group of men can advantageously arrange a nation's material, intellectual and spiritual life on a plan to which all must conform.

E. J. RUSSELL.

# Experimental Physics

**Grimsehls Lehrbuch der Physik:** zum Gebrauch beim Unterreicht, neben Akademischen Vorlesungen und zum Selbststudium. Neubearbeitet von Prof. Dr. R. Tomaschek. Band 1: Mechanik, Wärmelehre, Akustik. Neunte Auflage. Pp. vii + 674. (Leipzig und Berlin: B. G. Teubner, 1936.) 19.80 gold marks.

THE new edition of "Grimsehl" needs no lengthy introduction to students of physical science. The present volume (mechanics, heat and sound) preserves its strictly elementary character —insisting on the view that physics is primarily an experimental science, and confining mathematical expositions to the very simplest applications of the infinitesimal calculus. Within these limits, the exposition of the subject-matter is as clear and interesting as ever, and the editor is to be congratulated on having covered a very wide ground without the slightest tendency to scrappiness in treatment. The treatment is, generally, classical, and, so far as gross mechanics is concerned, the editor has judiciously introduced matter which has not yet come within the compass of the ideas of the ordinary compiler of text-books —the section on sound, for example, deals briefly with threshold values, and we find diagrams giving *Lautstärke in Phon*.

There are here and there slight lapses. The description of the variation of surface tension with temperature is qualitative, and it is merely a matter of a few lines to give an account of the power law connecting these quantities; and the account of molecular surface energy is in need of revision. Surely, too, an account of the determination of the constant of gravitation can scarcely be called adequate which, after describing the Cavendish experiment, goes on to the statement, "Die neuesten und zuverlässigsten Versuche sind von Richarz und Krigar-Menzel 1896 in einer unterirdischen Kasematte in Spandau ausgeführt worden". There is no mention of the classic experiment of Boys, none of Poynting's balance method. Where one has to pick and choose, it is really important that the latest and most trustworthy values of physical constants should be listed and, in this respect, the experiments of Heyl (*Bur. Stand. J. Research*, Dec. 1930) should be quoted. Heyl used a torsion balance *in vacuo*; the large masses were steel cylinders 66 kgm. in weight, the

smaller masses were spheres of gold, platinum, or optical glass. Heyl finds for the constant of gravitation $G = 6{\cdot}670 \times 10^{-8}$ cm.$^3$ gm.$^{-1}$ sec.$^{-2}$. The value obtained by Richarz and Krigar-Menzel is $6{\cdot}685 \times 10^{-8}$, and Boys obtained $6{\cdot}658 \times 10^{-8}$. Birge lists the value $6{\cdot}664 \times 10^{-8}$ based on some *preliminary* experiments by Heyl.

The choice of experiments on the mechanical equivalent of heat is curious. Joule's primitive apparatus of 1843 is described and illustrated, as are a laboratory apparatus devised by Grimsehl and some of Hirn's impact experiments. Descriptions of such experiments have certainly considerable cultural value; but when a value of a physical constant is listed in heavy type as correct to four significant figures, it is very desirable that some account should be given of the most recent experiments on which the final value is based.

The reviewer does not wish to convey an erroneous impression of the merits of the book, and it must be emphasised that there are but few of such lapses to record. The reader will find Prof. Tomaschek's edition of "Grimsehl" a pleasant and valuable guide to the fundamental principles of physics.

A. F.

# Design Argument Restated

**(1) The Purpose of God**
By the Very Rev. W. R. Matthews. Pp. 182. (London: Nisbet and Co., Ltd., 1936.) 7*s*. 6*d*. net.

**(2) The Hope of Immortality**
By the Very Rev. W. R. Matthews. Pp. 87. (London: The Student Christian Movement Press, 1936.) 2*s*. 6*d*. net.

(1) PROBABLY, the argument for theism which appeals most to the average man is the argument from design. Kant's philosophical criticism, and the biological theory of natural selection, are usually supposed to have weakened its force. Dr. W. R. Matthews, in the volume before us, examines it afresh.

The revelations of modern astronomers do not seem to Dr. Matthews to have helped matters much. The progress of knowledge has, on the contrary, "increased the sense of mystery and incomprehensibleness to such a degree that it is often difficult to feel that we are in a friendly universe". The teleological argument "gains nothing". The impression grows upon us "that we are in a world which is alien to our values, indifferent to our hopes, and, if purposive at all, is directed towards ends for which we are irrelevant".

The truth is that nothing much can be done with the "design" argument so long as "we make the false abstraction of considering nature apart from the mind which knows nature". The point is that somehow Nature has produced minds which "begin to understand it, to form estimates of it, and, as we are compelled to believe, are advancing in their knowledge of it". "The process of nature begins to understand itself and to value itself in the consciousness of human thinkers. Here is the most secure foundation of the teleological argument".

Dr. Matthews's argument is that the "emergence" of mind and knowledge are unintelligible unless the course of evolution is directed, and that on any other view "it is impossible to see how there can be any reliance on the power of mind to know truth".

That any theory of evolution which does not admit that mind directs the process, must "when thought out, lead to a negation of the possibility of knowledge, and therefore of the truth of the theory of evolution itself", was argued by the late Lord Balfour. But we are not sure that there is not a way out of this *impasse*. It might be argued from the evolutionary point of view that organisms have developed minds to enable them to deal more efficiently with their material environment (Schopenhauer pointed out that as sight is to touch, so reason is to sight—sight gives the organism a wider range than touch, and reason than sight). That their minds *do* enable mind-endowed organisms like men to deal with their material environment, does seem to guarantee the knowledge supplied by mind—at least to a sufficient extent to satisfy most of us. That minds *have* been evolved for this special purpose seems to be suggested by the failure of minds to cope with certain kinds of knowledge—as was pointed out by Bergson, who brought up to date the "paradoxes" of Zeno. The point is that the mind, even if posterior and not anterior to matter (that is, on the materialistic no less than on the idealistic theory), is a trustworthy instrument *for its purpose*. Most civilised people believe in the same system of fact and theory.

In the same way Dr. Matthews argues that "there can be no way of justifying the validity of human judgments of value except on the hypothesis that the prior stages of evolution were guided by some power which had regard to values

and intended them". But is a philosophic theory of this sort necessary to account for the fact that, as Mr. Michael Roberts has pointed out, while from time to time some of the admirers of Wagner go over to Beethoven, the process is never reversed? Nor does a man pass from Donne to Rupert Brooke. Why? Is there nothing objective about æsthetic sensibility apart from some theory about the origin of values?

We have chosen to indicate some reflections which will probably occur to scientific readers of this book, of whom, it is to be hoped, there will be many. This very able essay in constructive apologetic indeed deserves the thoughtful attention of students of science.

(2) The publication of Dr. Matthews's broadcast lectures on immortality will be widely welcomed. The Dean deals with this vast subject with economy and lucidity. Many who heard these admirable talks will be glad to have them in a permanent form, since they are certainly of permanent value. J. C. H.

# The League of Nations

(1) The Aims, Methods and Activity of the League of Nations

Pp. 220. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1935.) 2*s*.

(2) The League of Nations and the Rule of Law, 1918–1935

By Sir Alfred Zimmern. Pp. xi+527. (London: Macmillan and Co., Ltd., 1936.) 12*s*. 6*d*. net.

ON very different scales, both these books attempt not merely to describe or assess the achievements of the League of Nations but also to trace its development from early efforts and experiments in international organisation and co-operation.

(1) In the first and smaller volume, the greater part of the book is devoted to a well-balanced account of the activities of the League, including brief reference to the work of the Permanent Court of International Justice and of the International Labour Organisation. This description of the League's achievement is admirably done and, without being burdened by too great detail, enables the reader to appreciate how large a place the League already occupies in the relations of nations, despite the limitations on its efforts in the political field, and the evident weaknesses at the present time. Together with the concise description of the League's framework and methods, it should enable the reader to form an idea of the causes of some of the League's failures, and of the conditions under which it might function much more effectively.

(2) Sir Alfred Zimmern works on a larger canvas. Deliberately excluding the discussion of individual problems, he passes over many phases of the League's activity and, although a third of the book is occupied by a historical sketch of the League, he deals with only the main characteristics of the four phases into which he divides that history. It is, however, his approach to the subject which invites the special attention of the scientific worker.

Starting with the pre-War relations between States and the methods of co-operation which had then been developed, Sir Alfred describes the evolution of the Covenant out of the ideals and projects stimulated by the Great War and of the actual experience of international co-operation in allied shipping control and the like. He thus endeavours to set the actual form of international co-operation represented by the League of Nations against the background of experience in this field which we have already acquired, and in the light of this to estimate alike the causes of its failure and the possibilities of its further development or future success.

The outcome of this essentially scientific approach is a little disappointing. To some extent the reader is prepared for this by the warning against the difficulties besetting the scientific inquirer and the caution to be used in handling all books dealing with the League which prefaces Sir Alfred's sketch of its history. Moreover, he admits at the outset his doubt whether he is writing of an experiment which has reached its conclusion or describing the early phases of a living and developing institution.

That doubt is largely justified by the present political situation, but whatever the immediate issue may be, the material assembled in these books will leave no doubt in the mind of the scientific reader that the experiment must be continued in some form or other. If Sir Alfred has comparatively little to say, either in description or appraisement, of the technical side of the League's work in fields such as health, communications and transit, etc., where the League's committees have given a remarkable demonstration of the way in which knowledge and power can be linked, he

suggests that success in this field has to some extent made co-operation more difficult in the political field.

This aspect of co-operation, overshadowed as it may be by political questions at the moment, cannot be dismissed so cavalierly. Others besides the scientific worker may be disposed to inquire why a like approach should not be possible to all those difficult problems in the political field which threaten the peace of the world at the moment, and Sir Alfred himself has indicated some of the factors involved in such an approach. No means of promoting the quantity or technique of international co-operation can be neglected. Both alike increase the probability that the existing organisation for co-operation such as the League provides will be used. Equally the study of the technique of co-operation not merely supplies warning of the defects or dangers of existing organisation for co-operation but also assists in the modification or development of that organisation to meet changed conditions. Sir Alfred's conclusions in fact underline this necessity for a continually developing organisation for international co-operation, both to provide the machinery for settling disputes, and also to assist its members in discovering sensible ways of dealing with their own affairs.

Both books can be heartily welcomed as assisting the reader to arrive at that impartial and accurate knowledge of the functions and achievements of the League upon which alone its authority is finally based, and without which we can scarcely hope for that new spirit in the whole field of international politics which is the central problem of the League.

R. BRIGHTMAN.

# Principles of Genetics

**Genetics**
By Prof. H. S. Jennings. Pp. 351. (London: Faber and Faber, Ltd., 1935.) 15s. net.

THE extraordinary growth of genetics as a science has been accompanied by the publication of innumerable volumes giving general accounts of progress or more detailed studies of particular fields. The contributions of Prof. Jennings to this subject have been notable, especially his work on the Protozoa and on the mathematical rules of segregation. His writings, moreover, bear the hall-mark of clarity and orderliness of thought. They are therefore well adapted for the introduction of these aspects of biology to the general reader. Another notable aspect of Prof. Jennings's books is that he does not confine his biological conclusions to animals and plants, but brings them home directly by their application to man himself. The present volume will sustain his reputation as a thinker who faces the biological and eugenic conclusions to be drawn from genetical research.

This volume is a presentation of the general features of genetics such as every educated person should know. It is not intended as a technical introduction, but it points out and enlarges upon those aspects of the subject which the intelligent layman will wish to understand. The first chapter deals with the hereditary material, the chromosomes, which are passed on from cell to cell and from generation to generation. In Chapter ii this "genetic system" is considered in contrast with the muscular or the nervous system. The picture of meiosis given at this stage is obviously incomplete, corresponding with knowledge about twenty-five years ago. But the author in his treatment follows the history of the development of knowledge, the more recent phenomena of linkage and crossing-over being considered in Chapter vi under the constitution of the chromosomes.

Sex-linked inheritance is explained, first from the well-known cases of hæmophilia and colour blindness in man, and afterwards from the phenomena in *Drosophila*. "The relation of genes to characteristics" considers multiple, duplicate and modifying factors in *Drosophila* and the action of genes in development, but it ends characteristically with a study of physical and mental inheritance in identical human twins, which is continued in the next chapter on the "relation of characteristics to the environment", where the facts are set forth clearly and without bias. The last two chapters, on genetic variations, refer to mutations in many organisms and the methods by which they originate.

In a work of this kind, where choice of topics is essential, there are many which might have been included, but the author wisely emphasises principles rather than facts, and the book can be recommended to every reader who wishes to have an understanding of genetics in its biological aspects and relations rather than a detailed treatise on the subject. Among slips noted is the statement (p. 169) that the garden pea and the sweet pea have eight chromosomes.

R. RUGGLES GATES.

### A Fugue in Cycles and Bels

By John Mills. Pp. vii+269. (London: Chapman and Hall, Ltd., 1936.) 13*s*. 6*d*. net.

THE author points out that music in past ages has developed "without benefit of physics, except in so far as the simple rules of Pythagoras gave support to certain musical intervals against possible changes in taste, or style . . ." In this book an account is given of modern developments arising from successful efforts to improve the transmission of music and speech. The two chief factors are pitch and frequency, the latter here denoted in the title as cycles; and intensity and loudness, indicated by 'bels'. If one sound is ten times as loud as another, it is one 'bel' higher in sound level. If $A$ is about 25 per cent louder than $B$, then $A$ is one 'decibel' (db.) above $B$. The necessity for some such scheme arises from the fact that a full orchestra may vary in sound energy from about 70 watts down to a few microwatts, with a ratio of ten million to one, so that a logarithmic notation is required, and in this particular case the range is clearly 7 bels, or 70 decibels.

Although in most cases frequency and pitch may be deemed equivalent, yet an increase of intensity, without change of frequency, will produce an alteration of pitch. Thus it is stated (p. 117) that Stevens of Harvard has found that "if the power-level of a 150 cycle tone, as it reaches the ear, is 76 db. the frequency of the reference tone has to be reduced to 145 cycles (at a low power) to be equal in pitch". The latest determination of the threshold of audition is stated (p. 85) to be $10^{-16}$ watts. This extreme sensitivity of the ear and mind is combined with marvellous delicacy of analysis.

The book also deals in an interesting way with questions of transmission, distortion, overloading, noise, reverberation and auditorium acoustics. The final part presents and explains plots and graphs obtained mainly at the Bell Research Laboratories, New York.

### The Book of Minerals

By Alfred C. Hawkins. Pp. xii+161. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 7*s*. 6*d*. net.

THE professed purpose of this little book is "to tell to the people the story of the minerals", and to this end the author has been careful to keep his text free from all technicalities. The opening section offers brief advice on where to look for minerals and how to collect them, "how to tell minerals apart" (by means of hardness, specific gravity, blowpipe tests, etc.), and gives some account of crystals and their classification. The main part of the book contains short descriptions of the most common minerals, well illustrated with photographs of museum specimens.

To one knowing nothing of the subject "The Book of Minerals" would provide a pleasant companion for a walk round a museum collection. The young collector, for whom in many ways the book seems to be designed, would soon reach a stage when this "Mineralogy without Tears" would no longer satisfy his growing thirst for knowledge. B. W. A.

### Tabulæ Biologicæ Periodicæ

Herausgegeben von C. Oppenheimer und L. Pincussen. Band 3, Nr. 4 (=Tabulæ Biologicæ, Band 9, Nr. 4). Pp. iv+321–436. Band 3, complete, 55 gold marks. Band 4, Nr. 1 (=Tabulæ Biologicæ, Band 10, Nr. 1). Pp. 160. Band 4, complete, 55 gold marks. Band 4, Nr. 2–3. (=Tabulæ Biologicæ, Band 10, Nr. 2–3.) Pp. 161–208; 209–288. (Den Haag: W. Junk, 1934.) 55 gold marks.

THE data given in these numbers of the "Tabulæ Biologicæ" will be of interest to all biologists. The last part of vol. 3 concludes the list of polypeptides acted upon by erepsin and trypsin, and also tabulates the compounds hydrolysed by various amidases. The remainder of the number is devoted to a list of plants cultivated for their food or of commercial value, including their natural habitat, centres of cultivation, use and finally chromosome number. An index to the volume is included.

The first part of vol. 4 has sections dealing with redox-systems, respiratory pigments and the blood groups of the different nations of the world (which is concluded in No. 2 of the volume). Other sections deal with the influence of light on the germination of seeds and the physiology of the Myriapoda. No. 2 also includes data on the kidneys and a list of acids found in lichens. No. 3 has three sections only: a list of the less common elements found in the tissues of different animals; data on the skulls of prehistoric man and finally a second article on the biology and toxicology of gases, vapours and sprays used in warfare. The material of this journal does not lend itself to a more detailed review, but the data should prove extremely useful for those interested.

### Probability and Random Errors

By Dr. W. N. Bond. Pp. viii+141. (London: Edward Arnold and Co., 1935.) 10*s*. 6*d*. net.

THIS is a bright and original treatment of a subject voted by many as dull, however necessary it may be for the experimentalist to discuss with care the accuracy of the end result of his measurements and calculations. The book is addressed primarily to students of physics and chemistry, but others will find it interesting and useful. It begins with questions of pure probability, leading up to the discussion of problems of random migration and kindred topics that are of interest to the modern physicist. Various types of error are listed, and a chapter is devoted to their estimation. We then have an unusually full chapter giving the probable errors of various combinations of measured quantities. The fitting to data of the straight line and parabola is described, together with examples of the fitting of other types of curves. The first part of this section might have been simplified arithmetically, since the data are in all cases equally spaced, by giving a method, such as that of Aitken, based on orthogonal polynomials. A chapter on periodogram analysis follows, and the book ends with a number of miscellaneous examples, and with two short appendixes, in one of which the formulæ of the book are conveniently summarised for reference.

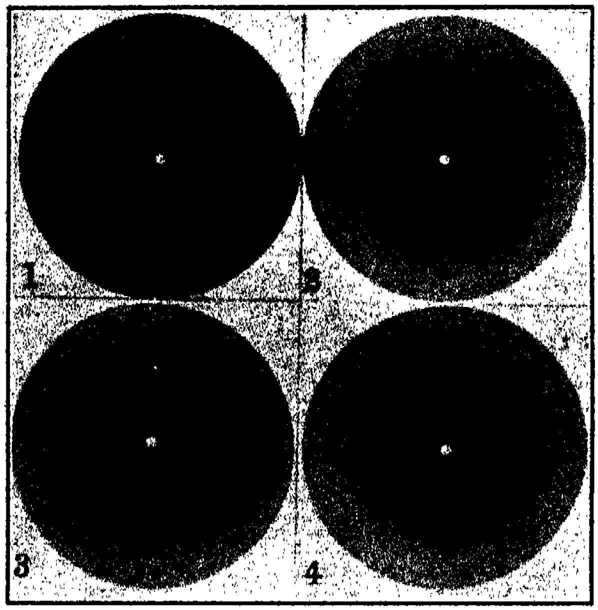
# X-Ray Studies of Protein Structure*

By W. T. Astbury, Textile Physics Laboratory, University of Leeds

ACCORDING to the classical researches of Fischer and others, proteins would appear to be essentially polypeptides, giant molecules formed by the repeated condensation of α-amino-acids. This concept leads naturally to the idea of long chain-molecules like that of cellulose, the structure of which was worked out some years ago by a particularly happy combination of chemical and X-ray methods[1]. Similar methods applied to one of the simplest proteins, *fibroin*, the fibre substance of natural silk, show that, for silk at least, the hypothesis is substantially correct[1]; that, in fact, this fibre is a kind of molecular yarn or sliver built up by chain-like molecules, fully-extended polypeptides, lying roughly parallel to the fibre axis. The approximate dimensions of these chain-molecules may be predicted from atomic data already available, and they are found to fit in well with the results of X-ray analysis.

The X-ray photographs of all natural protein fibres, hair, muscle, collagen, feather, etc., show certain features in common with that of natural silk, and it seems clear that they are all built up in very much the same manner from chain-molecules lying along, or simply related to, the fibre axis. But in other respects there are well-marked differences which indicate that the straight-chain configuration found in silk cannot be true in general. Specially does this objection hold in the case of mammalian hair. On stretching hair, however, a new X-ray photograph is obtained which shows again the characteristics of fully-extended polypeptides. The chain-molecules of *keratin*, the protein of hair, must therefore be normally in some regularly folded state from which they can be pulled out straight, and to which they return when the tension is released[2].

Mammalian hairs, spines, horn, etc., are elastic over a range recalling even that of rubber, and X-rays thus indicate that the property resides in the keratin molecule itself, which can be transformed from a folded configuration (α-keratin) to the straight-chain configuration (β-keratin) and back again an indefinite number of times. The structure of β-keratin[3] (Fig. 2) appears to be that of a polypeptide 'grid' built up by interactions and combinations between the various 'side-chains' of neighbouring 'main-chains'. To accommodate these interactions the grid buckles, so to speak, in such a way that the main-chains fold in planes transverse to the side-chains. In the presence of water the folds can be pulled out by mechanical force, but they resume their normal configuration when the stretching force is removed. The basis of the 'setting' of hair when steamed in the stretched state is the hydrolytic breakdown of certain of the cross-linkages of the grid which are put under stress when the molecule is stretched. The broken cross-linkages then ultimately re-form in new (unstressed) positions, thereby eliminating the driving force of contraction. If, however, the cross-linkages are broken but not allowed to re-form, a more labile state is induced in which the (modified) keratin molecule can be made to contract to a length even shorter than that of normal α-keratin ('supercontraction').




FIGS. 1–4. X-ray photographs of (1) a protein in the α-configuration, (2) a protein in the β-configuration, (3) disoriented denatured protein, and (4) stretched denatured albumin. (Fibre axis or axis of extension vertical.)

The X-ray photograph of washed and dried muscle (Fig. 1) is remarkably like that of α-keratin[4,5]. The photograph in the main arises from the chief muscle protein, *myosin*[6], which must be presumed to exist normally in a folded, or α-, configuration. If, therefore, the elastic elements in muscle are by analogy with keratin the myosin chain-molecules, the contraction of muscle corresponds to the 'supercontraction' of keratin, and it should be possible to transform both myosin and muscle into a straight-chain, or β-, configuration[4]. These transformations have now been accomplished[5], by stretching myosin film and washed muscle

* Substance of three lectures delivered at the Royal Institution on February 20 and 27 and March 5.

respectively, and the former has also been made to show 'supercontraction' after the manner of the contraction of muscle itself[6,7]. Figs. (1) and (2) are typical α- and β-photographs, respectively, (1) being that of the foot retractor muscle (washed and dried) of *Mytilus edulis*, and (2) that of stretched horn.

Considering now these two further points: (*a*), that in spite of the close resemblance between their X-ray photographs the sulphur content of myosin is quite small compared with that of keratin, which among proteins is outstandingly rich in sulphur; and (*b*), that the side-chain breakdown shown by X-ray analysis to precede the supercontracting state of keratin has been found by Speakman[8] to be largely concerned with the cystine –S–S– linkage between neighbouring main-chains, we gain the strong impression that hair protein is no other than a kind of muscle protein 'vulcanised' in order to reduce its elastic sensitivity and at the same time impart resistance to chemical attack.

The molecule of feather keratin appears to be in a slightly contracted β-configuration. X-rays show that it can be stretched continuously and reversibly over a range of some seven per cent[9].

Svedberg's investigations with the ultra-centrifuge[10] indicate that the molecules of many soluble proteins are large globular units or combinations of such units, and crystallographic examination and certain X-ray results support this view. Most X-ray photographs, however, taken without any special precautions, suggest almost the antithesis of this and indicate that the molecules either consist of, or generate spontaneously, polypeptide chains configurationally analogous to β-keratin. The idea thus takes shape that most proteins as usually examined by X-rays are in a degenerate state, that their original specific configuration has broken down partially or completely to form dis-oriented polypeptide chain-bundles[11]. The hypothesis is further strengthened by the observation[11] that when proteins are deliberately 'denatured', for example by heat, the resemblance to dis-oriented β-keratin becomes even more pronounced. This will be clear by comparing Figs. (2) and (3), the latter being a powder photograph of boiled egg-white—or for that matter, to all intents and purposes, any denatured protein. A crucial test, therefore, is to see whether it is possible to obtain an X-ray photograph like that of *oriented* β-keratin simply by stretching a denatured protein.

This test has now been carried out, and artificial fibres and films of denatured albumins and globulins have been shown to give, on stretching, X-ray photographs typical of oriented bundles of fully-extended polypeptides. The crystallographic orientation, though, of these photographs is not always the same: whereas stretched denatured edestin, for example, gives a photograph like Fig. (2), corresponding to chains lying *along* the axis of extension, a stretched film of 'poached' egg-white gives a photograph like Fig. (4), corresponding to chains lying *across* the axis of extension. The observed types of photograph can be explained only on the assumption that the polypeptide chains in denatured albumins are in general much shorter than those in denatured globulins[11].

It should be noted that films and fibres of denatured proteins are elastic, and often over a great range, presumably because the denaturation process usually results in a random, and maybe sometimes incomplete, liberation of chains which in part coalesce into bundles and in part remain in an irregularly coiled-up state from which they may be pulled out by tension, rather in the manner of the polyprene chains when rubber is stretched.

The immediate question of the future concerns the precise relation or relations between the 'globular' proteins and the chain-molecules to which they give rise so readily. Which is the more fundamental, the globular form or the chain form, and is one obtained from the other by a process of simple coiling or uncoiling, or is the chain form a consequence of the linear polymerisation or condensation of the globular form? At the moment there is evidence for both possibilities[12], though it seems more likely that in general denaturation involves little more than (*a*) the dissolution of intramolecular co-valent linkages, in particular the –S–S– linkage, (*b*) the uncoiling of a chain system, and finally (*c*) the coagulation or 'crystallisation' of the liberated chains into bundles configurationally analogous to those of β-keratin[11]. It must be emphasised, however, that though denaturation appears always to lead to the formation of polypeptide chain-bundles, it does not follow that all chain-bundles are necessarily denatured. The muscle protein, myosin, for example, may be said to be 'configurationally disposed' towards denaturation—and indeed it denatures with extreme ease—but so long as it is not allowed to dry it tends to remain soluble. It is clear that if irreversibility is to be avoided, then at least the chains must be kept from too intimate relations with one another.

What then constitutes reversibility of denaturation, if there is such a thing, and Anson and Mirsky[13] maintain that there is? At the moment, the answer given by X-rays would appear to be this, that it is determined by (*a*) the extent to which a globular protein may be uncoiled reversibly, and (*b*) the possibility of keeping the liberated chains from agglomerating into parallel bundles; or in other words, of avoiding more intimate or widespread interaction than obtained in the original globular configuration. Much seems to

depend on the way the globular proteins are built up in the first place. If they are built up piecemeal and not by the coiling of one or more polypeptide chains, then reversible uncoiling is perhaps unlikely.

A purely formal approach to the constitution of the globular proteins may be made by combining the results of X-ray analysis with the study of protein monolayers. From the X-ray examination of the fibrous proteins we must conclude that in fully-extended polypeptide chains, in β-keratin or denatured edestin, for example, the average length of an amino-acid residue is about $3\frac{1}{2}$ A., its thickness is about $4\frac{1}{2}$ A., and its average width in the side-chain direction is about 10 A. The density of a fibrous or denatured protein, therefore, should be about $0{\cdot}0105R$, where $R$ is the average residue-weight of the amino-acids in question. If we take $R$ to be of the order of 120, this gives a density of 1·26 gm. per c.c.—and it is a fact that proteins do have very much this sort of density. Similarly, protein monolayers formed of parallel arrays of more or less fully-extended polypeptides with their side-chains dipping into the substrate should have a common area (not allowing for hydration) of about $95{\cdot}5/R$ sq. metres per mgm.; that is, for $R=120$, about 0·795 sq. m. per mgm. Now Gorter and his collaborators[14], for example, find always in the region of $p$H 1 an area (extrapolated to zero pressure) of the order of 1 sq. m. per mgm., and a similar area often at the isoelectric point also, whether the molecular weight be 35,000 (Svedberg's 'unit') or a multiple of that; for example, insulin ($p$H 5), 0·875: pepsin ($p$H 2·7), 1·0: zein ($p$H 5·5), 1·07: ovalbumin ($p$H 4·7), 0·88: casein ($p$H 4·6), 1·04 sq. m. per mgm. The natural conclusion is that protein monolayers, under certain conditions at least, are formed by the liberation of polypeptide chains from an originally globular configuration in something the same way as in the process of denaturation.

A further helpful step forward was made by Gorter[15] when he showed that the area of a protein monolayer, under the conditions defined above, corresponds to that of a set of spheres of radius about 22 A., which is the radius found by Svedberg for his spherical units of weight 35,000. (More recently Bernal and Crowfoot, in the only reasonably successful X-ray analyses of unaltered single protein crystals so far accomplished, have arrived at a similar result for the molecules of pepsin and insulin[16].) Gorter's result may also be derived from first principles by means of the X-ray data given above; but it is difficult to proceed to the obvious inference that globular proteins are by way of being simply curved monolayers with the side-chains directed radially, because the calculated density (about 1·14) of such systems is too low.

It is a significant fact that the density of the globular proteins is roughly the same as that of the fibrous proteins. What other possibilities are there then that conform to Gorter's finding? One is the cylinder whose height is equal to its diameter, and whose area, therefore, is again $4\pi r^2$, but the calculated density of this (about 1) is still less satisfying. Actually there is no solution along these lines *except by building a system out of pieces of monolayer separated by the characteristic 'side-chain spacing' found by X-ray analysis. We have thus to place four disks of monolayer of diameter about 40 A. on top of one another at a distance of about 10 A. apart.* Both the weight and the dimensions then correspond to those of Svedberg's units, the density is correct, and the area of the liberated monolayer would be equal to the surface area of spheres of the same diameter. Furthermore, though X-ray data on the globular proteins are still so meagre, such an arrangement fits in well with present indications[11,12] that their structure must in many cases be somehow closely related to that of the fibrous proteins.

Just recently, Wrinch has arrived at similar conclusions along quite different lines of reasoning[17]. In effect, she has succeeded in generalising the two features of the α–β keratin transformation that it was found necessary to postulate in order to explain quantitatively the experimental facts: (*a*) that the chain should fold hexagonally at regular intervals, and (*b*) that the side-chains should stand out transverse to the plane of folding. Perhaps there is some justification then after all for the suggestion[18] that in a way keratin is the grandfather of all proteins.


[1] K. H. Meyer and H. Mark, "Der Aufbau der hochpolymeren organischen Naturstoffe", 1930.

[2] W. T. Astbury, *J. Soc. Chem. Ind.*, **49**, 441 (1930). *J. Text. Sci.*, **4**, 1 (1931). "Fundamentals of Fibre Structure", 1933. W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75 (1931).

[3] W. T. Astbury and H. J. Woods, NATURE, **126**, 913 (1930); *Phil. Trans. Roy. Soc.*, A, **232**, 333 (1933); W. T. Astbury and W. A. Sisson, *Proc. Roy. Soc.*, A, **150**, 533 (1935); H. J. Woods, NATURE, **132**, 709 (1933).

[4] W. T. Astbury, *Trans. Faraday Soc.*, **29**, 193 (1933); Cold Spring Harbor Symposia on Quantitative Biology, **2**, 15 (1934); *Kolloid-Z.*, **69**, 340 (1934).

[5] W. T. Astbury and S. Dickinson, NATURE, **135**, 95, 765 (1935).

[6] G. Boehm and H. H. Weber, *Kolloid-Z.*, **61**, 269 (1932).

[7] H. H. Weber, *Pflüg. Arch.*, **235**, 205 (1934).

[8] J. B. Speakman, NATURE, **132**, 930 (1933); Jubilee Issue of *J. Soc. Dyers and Colourists*, **50** (1934).

[9] W. T. Astbury and T. C. Marwick, NATURE, **130**, 309 (1932); W. T. Astbury, *Trans. Faraday Soc.*, **29**, 206 (1933); *Kolloid-Z.*, **69**, 340 (1934).

[10] See, for example, *Chem. Reviews*, **14**, 1 (1934), and numerous papers in NATURE, *J. Amer. Chem. Soc.*, *Kolloid-Z.*, etc.

[11] W. T. Astbury and R. Lomax, NATURE, **133**, 795 (1934); *J. Chem Soc.*, 846 (1935).

[12] W. T. Astbury, S. Dickinson, and K. Bailey, *Biochem. J.*, **29**, 2351 (1935).

[13] See papers in *J. Gen. Physiol.* over the last ten years.

[14] E. Gorter and F. Grendel, *Trans. Faraday Soc.*, **22**, 477 (1926); *Proc. Kon. Akad. Wetensch.*, **29**, 1262 (1926); *Biochem. Z.*, **201**, 391 (1928); E. Gorter, J. van Ormondt, and F. J. P. Dom, *Proc. Kon Akad. Wetensch.*, **35**, 838 (1932); E. Gorter and J. van Ormondt, ibid., **36**, 922 (1933); *Biochem. J.*, **29**, 48 (1935); E. Gorter and G. T Philippi, *Proc. Kon. Akad. Wetensch.*, **37**, 788 (1934); E. Gorter, ibid., **37**, 20 (1934); *Amer. J. Diseases of Children*, **47**, 945 (1934); *J. Gen. Physiol.*, **18**, 421 (1935); E. Gorter and W. A. Seeder, ibid., **18**, 427, (1935); etc.

[15] E. Gorter and F. Grendel, *Proc. Kon. Akad. Wetensch.*, **32**, 770 (1929).

[16] J. D. Bernal and D. Crowfoot, NATURE, **133**, 794 (1934); D Crowfoot, ibid., **135**, 591 (1935).

[17] D. M. Wrinch, NATURE, **137**, 411 (1936).

[18] W. T. Astbury, *Kolloid-Z.*, **69**, 340 (1934); W. T. Astbury and R. Lomax, NATURE, **133**, 7[illegible]

# The Rabbit in Australia

TO-DAY every country is shy of introducing any mammal or bird which is not already a permanent resident, recognising that it may introduce a fresh element upsetting the balance of Nature of its land. Great Britain has had experience of the black and brown rats for centuries, perhaps accidental introductions; and has lately incurred liabilities, which may be enormous, by the purposeful introduction of the American musk-rat, already the major pest of Central Europe; and the escape of the grey squirrel from the London Zoo. The rabbit also is held by Hinton to have been an introduction by the Normans; there are no mentions of warrens in Domesday Book. The English sparrow is only too well known in the United States and other countries. All pale into insignificance when compared with the rabbit in Australia, which, if control fails, will assuredly devastate a continent. The earliest arrivals, probably domesticated forms, were passengers on the first fleet of settlers 149 years ago. In Tasmania, rabbits were "running about some of the large estates in thousands" by 1827. Many of the smaller islands were also being stocked to provide food for shipwrecked mariners. On the mainland such areas where they flourished were hemmed in by forests, containing natural enemies, carnivorous mammals and birds. Then in 1859, two dozen wild rabbits were introduced to a Geelong estate, on which 20,000 were killed in the next six years, an estimated stock of 10,000 being left. To-day, three quarters of the continent is over-run.

The rabbit was originally an inhabitant of North Africa and southern Europe. The Romans carried it everywhere, sometimes (Majorca) with disastrous results. It is extraordinarily prolific, commencing to breed at four months of age and dropping up to six litters a year with an average of six young at each. The young can look after themselves when a fortnight old. If in any country there are suitable crevices in rocks or holes in the ground or protection by fallen timber, the young rabbit does not burrow, but in open country they dig holes, extending to 7–8 feet deep and often to great length; thus many living together form extensive warrens. The doe excavates a special burrow of its own, usually near the surface of the warren, where the earth is easiest to dig.

Essentially, the rabbit is an inhabitant of the plains, and at Geelong were the plains which form the greater part of Australia, with no enemies capable of keeping such a prolific animal in check. The inhabited parts were mostly laid out in sheep runs. Competition commenced, both rabbits and sheep eating the same food; the rabbit preferred the finer and more nutritious grasses and was a closer feeder and thus won in the struggle. So long as they were not too numerous, the stockmen liked them, for what did it matter if they were a few sheep less, while they had a variety in their food and especially a perquisite by the sale of rabbit skins. It was very shortsighted, for when drought came, the rabbit always won, for the sheep died first and more than sufficient rabbits were left. Then came wet seasons and the rabbit multiplied and pushed out into the semi-desert with its isolated bushes and low trees and its tussocks of grass. In turn drought came; the grass was eaten and the bush and the trees ringed and killed. What were merely 'dry lands' become desert with no plants to hold the drifting sand. Sheep cannot live on prickly pear, the only vegetation left, but rabbits can. In Australia the immediate problem is *the productivity of wool and* mutton reduced to about half in many pastoral districts; when the quantities of these are so reduced that the land no longer pays, it is gradually converted to desert.

The experiments in control at first made in Australia failed. The fox, who listens for the doe and her young and digs them out, was introduced, but the fox turns his attention to lambs and chicken—and, of course, kills out much of the native fauna. The efforts of Governments were mainly to prevent the spread of rabbits; thus Queensland tried to protect itself by no less than 6,303 miles of wire fencing. Ring fences were erected in places and often separate stations within these were again ringed. Western Australia ran a fence 1,139 miles without a break, and as part of this seemed ineffective two subsequent inner fences of 724 miles and 160 miles. Trapping and digging are too expensive—and poisons, while undoubtedly effective at times, never clear the whole stock; and they kill everything harmful and beneficial, fur and feather. Carbon disulphide was used as a fumigant, but even in a burrow its effect is very brief and many rabbits escaped; the same applies to carbon monoxide. Then the natural diseases of rabbits were studied and a virus was tried, but there was always left a resistant stock with which to carry on.

Mr. D. G. Stead, as Rabbit Enquiry Commissioner to the State of New South Wales, now

advocates the use of 'Cyanogas'*, and this to us seems the soundest proposal as yet formulated. Cyanogas is calcium cyanide in dust form, and this in contact with ground moisture or water vapour gives off hydrocyanic acid gas, which is the most deadly fumigant known. It is quite safe to handle in the portable foot machine, and the method is to blow a few puffs into the mouth of a warren, their number depending on its size, and then to close up and stamp down every hole with the spade, and leave the warren, into which dogs had previously driven all wanderers. The Cyanogas takes up to a day to decompose and is all this time giving off its gas, which diffuses so well that it penetrates to every part of the burrow.

Mr. Stead's figures are convincing, and his claim that this fumigant gives "the greatest kill possible" and entails "the least possible use of time and energy" seems justifiable; certainly at the estimated cost of 6*d.* per acre (or even at four times as much!) its use means "the lowest cost". In Australia it is claimed that the better sheep lands could be thus safeguarded, and their extra productiveness in wool and flesh would mean a handsome profit on the deal. Is it not also equally applicable to England, where rabbits have been selling everywhere in the country at 6*d.* a piece or less in the past winter? The shooting of rabbits is poor sport, and the eaten-off crops that surround many fields mean often a loss of 10 per cent of the crop of a farm, and must be abolished, if farming is to pay. No doubt the Ministry of Agriculture is alive to the use of Cyanogas, but in our experience few farmers or land owners know of it, and those who do mostly regard its use as highly dangerous. It is a fumigant applicable to the brown rat and perhaps the musk-rat, but in each case it requires to be used according to the mode of life of the beast. In any event, there is some hope now that these rodent pests may be controlled.

J. S. G.

* The Rabbit in Australia: History, Life Story, Habits, Effect upon Australian Primary Production and Best Means of Extermination. By David G. Stead. Pp. 108. (Watson's Bay, N.S.W.: The Author; London: University of London Animal Welfare Society, 1935.) 2*s* net.

# Obituary

## Prof. James Rice

JAMES RICE, who died on April 17 at the age of sixty-two years, was associate-professor of physics and reader in theoretical physics in the University of Liverpool. He was educated at the Royal Academical Institution, and the Queen's College, Belfast (now the Queen's University, Belfast), where he obtained the highest honours (Senior Scholarship and Dunville Studentship). In the Royal University of Ireland his career was equally distinguished (scholar, student and junior fellow), and at the examinations for the B.A. and M.A. degrees and the junior fellowship he was awarded the highest place in the first-class honours list in mathematical science. In 1902 he was appointed senior physics master at the Liverpool Institute, a post which he held until 1914, when he was appointed to a senior lectureship in physics in the University of Liverpool. In 1924 the University of Liverpool conferred on him the title and status of associate-professor, and in 1935 the additional title and status of reader in theoretical physics.

In the earlier part of his career, Rice was particularly attracted to those branches of mathematical physics which deal with thermodynamics, kinetic theory and classical statistical mechanics, and soon obtained a mastery of all these subjects. Being gifted with a keenly receptive and flexible mind as well as an outstanding ability in mathematical science, he soon became an enthusiastic and expert student of the new advances in theoretical physics—Planck's theory of the quantum of action, the Robb-Einstein-Minkowski theory of relativity, the Rutherford-Bohr theory of the atom, and the later advances in the quantum mechanical theory of atomic and molecular events due to Heisenberg, Born, Schrödinger, Bohr, Dirac and Weyl.

Rice's early mastery of the general theory of relativity was demonstrated in the clearest fashion by the publication in 1923 of his "Relativity; a Systematic Treatment of Einstein's Theory" (Longmans, Green and Co., Ltd.). Although not intended to compete with the great treatise of Eddington (from whom Rice's work received a highly favourable notice in the columns of this journal), this book dealt in a thoroughgoing fashion with the complete mathematical theory of the subject, and soon became the best text-book in the English language for serious university students of theoretical physics.

Being convinced of the fundamental importance of the new outlook on science and philosophy due to the concepts of the modern theory of relativity, Rice became a devoted advocate of these views and gave highly appreciated 'popular' lectures thereon in many parts of the country, being invited by the Parliamentary Science Group to expound the new ideas to the members. His book on relativity in Benn's well-known sixpenny series had an immense sale, and probably did more than any other work on the subject to spread the new concepts among the thinking and more intelligent sections of the British public. Throughout his whole life, Rice was an enthusiastic and expert apostle of the new and wonderful light that had come into the minds of

men. In his spirit there burned the pure and bright flame of a passion for knowing and for teaching those who would also know. Like those Irishmen of olden times who went forth to spread a new light throughout the world, he, too, felt he had a mission, and dedicated his life to it with a selfless devotion that had in it the same saintly quality.

Another example of Rice's mastery of the principles of modern theoretical physics is his "Introduction to Statistical Mechanics for Students of Physics and Physical Chemistry" (Constable and Co.), which was published in 1930. He had long contemplated a very comprehensive and advanced work on this subject, and had made many preparations for it, but the heavy calls on his time and strength made by his teaching work obliged him to confine his efforts to a smaller work. Nevertheless, Rice's "Introduction" has established itself in the affections of students of science throughout the world, and forms a very necessary and admirable preparation for a study of the advanced treatises of Fowler and of Brillouin, and the classical work of Willard Gibbs.

Prof. W. C. McC. Lewis, of the University of Liverpool, would be one of the first to acknowledge the valuable help he has received from Rice on many occasions. Students of his well-known treatise on physical chemistry will recollect the valuable contributions made by Rice to that important work.

Prof. Rice took a large part in the teaching of physics at the University of Liverpool. Besides lecturing to the advanced honours students, he gave for many years general courses on physical science, organised and supervised much of the practical laboratory work and was responsible for inspiring and guiding the work of many research students. Partly owing to his late entry into university work and largely owing to his wholehearted and unselfish devotion to the teaching of his students—and many of his friends of maturer age—he allowed himself little time for making personal advances in theoretical physics. Although he published a number of scientific papers, he will be chiefly known for his valuable books, which are gems of lucid scientific exposition of difficult branches of mathematical physics. He took an active part in the work of the Education Department of the University of Liverpool, for which his experience in teaching at the Liverpool Institute gave him special qualifications.

Rice cared much for the sorrows and troubles of his fellow-men, and took a deep and expert interest in the conditions of life and economic welfare of the workers in all classes of society. His warm heart and generous spirit could not tolerate any form of social injustice, and led him to take an active part in the work of the local branch of the Fabian Society.

Keeping himself constantly abreast of the newest advances in physical science, Rice possessed a marvellous power of assimilating this knowledge and explaining it to others. His constant aim at the University was to infuse the work of his students from the very beginning with the new concepts and principles of physics, rather than to ask students to unlearn their earlier knowledge and attack these fundamental matters as 'advanced work' in the later stages of their university life. Many generations of students both at the Liverpool Institute and at the University of Liverpool must owe him a very deep debt of gratitude for his inspired and inspiring teaching and his constant devotion to their interests. Most nobly and faithfully did he carry on the tradition of his great teacher at Queen's College, Belfast, Prof. William Blair Morton.

It may not be indiscreet to mention that an elaborate commentary on the scientific writings of J. Willard Gibbs will be published this year by the Yale University Press. In this commentary Prof. Rice was invited to participate, and contributed very important and valuable articles dealing with Gibbs's thermodynamical theory of heterogeneous equilibrium involving strained elastic solids and surfaces of discontinuity. In this work Rice returned to his earliest love, and demonstrated his complete mastery of two of the most difficult and recondite branches of thermodynamical science. It is sad to think that he will not see the publication of important work that cost him several years of intense thought—work that is surely destined to add further lustre to his reputation.

We, his many friends who live to mourn him, treasure in our hearts the memory of a sincere and affectionate friend and an eager, generous and unselfish spirit. He is survived by his devoted wife, but leaves no family. F. G. DONNAN.

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DR. LUDWIG DÖDERLEIN, formerly keeper of the Zoological Museum in Strassburg, died at Munich on March 23, 1936, aged eighty-one years. He graduated as Ph.D. at Bonn in 1877, with a thesis on the skeleton of a tapir. He visited Japan, and there collected many fishes, which were described by Dr. Franz Steindachner and himself in the memoirs of the Vienna Academy of Sciences between 1883 and 1887. In 1889 he co-operated with Prof. G. Steinmann in a text-book, "Elemente der Paläontologie", and afterwards devoted himself chiefly to the study of fossil vertebrates. His latest papers on pterodactyls were published by the Bavarian Academy of Sciences in 1929.

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PROF. ANTON GHON, formerly director of the Pathological-Anatomical Institute of the German University of Prague, died on April 23 at the age of seventy-one years. He had specialised in the treatment of tuberculosis, and had discovered, during his collaboration with Sachs, the so-called Ghon-Sachs bacillus. He was interred at his birthplace, Villach, in South Austria.

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WE regret to announce the following deaths:

Mr. H. G. G. Payne, director of the British Archæological School in Athens, on May 8, aged thirty-four years.

Sir Alfred Watson, K.C.B., Government actuary, who was president of the Institute of Actuaries in 1920–22, on May 7, aged sixty-six years.

# News and Views

### Sir Norman Lockyer, 1836–1920

No centenary can be mentioned more appropriately in NATURE than that of Sir Norman Lockyer, who founded this journal in 1869. Joseph Norman Lockyer was born at Rugby on May 17, 1836, so that the centenary of his birth falls on Sunday next. Throughout his career he worked with unceasing energy for the advancement of natural knowledge, and his spectroscopic researches, as well as his imaginative insight, place him in a high position among pioneers of modern science. The records of his contributions to astrophysics, and the recollection of the stimulating influence he exerted upon the progress of science for so many years, have increased in strength and value since his death on August 16, 1920; and they will command admiration so long as the pursuit of knowledge is regarded as worthy human endeavour. In the issue of NATURE of November 6, 1919, published to celebrate the jubilee of the foundation of this journal, Sir Norman Lockyer was the subject of an article in the series of "Scientific Worthies", and Dr. Henri Deslandres then referred to him as "one of the great men of science of England and one of the greatest astronomers of all time". How well he earned this high tribute of praise may be judged from the fine volume recording his "Life and Work" published in 1928.

### Helium

THE discovery of Sir Norman Lockyer's which stands out as one of the most romantic events in the history of science is that of helium. In 1866, Lockyer suggested that, with large enough dispersion, it should be possible to observe solar prominences in full daylight without waiting for the sun to be obscured in a total eclipse. Two years later, he became possessed of a spectroscope of sufficient power to make this observation, and he then noticed a strange yellow line in the spectra of solar prominences. This was at first supposed to be due to hydrogen, but experiments failed to confirm this opinion. After satisfying himself that the line could not be produced by any element then known on the earth, Sir Norman Lockyer called the unknown substance 'helium'. Not until twenty-seven years later was terrestrial helium extracted from cleveite by Sir William Ramsay, and since then it has proved to be one of the most interesting elements in both pure and applied science. For an element first discovered by an astronomer to prove in the course of time to have so many scientific and industrial contacts is a reward which few investigators can hope to obtain, and a tribute to an achievement which occupies a leading position in the archives of science.

### Guthrie Lecture: Prof. F. A. Lindemann, F.R.S.

THE Guthrie Lecture for this year of the Physical Society is being delivered at the Imperial College of Science and Technology, South Kensington, at 5 p.m. on May 15 by Prof. F. A. Lindemann, professor of experimental philosophy in the University of Oxford, whose subject is "Physical Ultimates". Prof. Lindemann has carried out theoretical and experimental researches in various branches of physics. Before the Great War he was distinguished for his work on the specific heat of solids at low temperatures; the Nernst–Lindemann formula was a pioneer attempt to connect the specific heat of a substance with its characteristic frequencies. During the War he was attached to the Royal Air Force, and the apparatus which he evolved and the experiments he performed himself in actual flight on the causes and elimination of spin were recognised as of the highest importance. In 1919, at a very early age, Prof. Lindemann was appointed to the chair which he now occupies at Oxford. He has written papers on the origin and nature of magnetic storms, and his research work on meteors gave the first indication of the then unsuspected rise of temperature at heights of about 50 km. in the upper atmosphere, which has since been verified in other ways. His development of photo-electric cells and the electrometer which bears his name have been of incalculable service, not only to the solution of the astronomical problems which interested him and his father, who had his own observatory at Sidmouth, but also to physicists in general. Recently he has turned his attention to the more philosophical aspects of physics, and in his book on the "Physical Significance of the Quantum Theory", he has attempted to clear up certain difficulties connected therewith.

### Bicentenary of the Duke of Bridgewater, 1736–1803

ON May 21 the bicentenary occurs of the birth of Francis Egerton, third and last Duke of Bridgewater, who has been called "the Father of British inland navigation", and to whom a monument exists at Ashridge bearing an inscription which says that "by devoting the energies of his mind to the accomplishments of the most splendid works of inland navigation, [he] opened a new field of national industry and rendered the most important services to the commercial interests of this country". A sickly, neglected boy, and an ignorant, awkward and unruly youth, the Duke was only twelve years of age when he succeeded to the title, and there was little promise in his early life that he would become one of the country's benefactors. A disagreement at the age of twenty-two with the widowed Elizabeth, Duchess of Hamilton, led to his leaving London for his home at Worsley near Manchester, and his whole life was henceforth devoted to the management of his collieries and estates. Obtaining an Act of Parliament in 1759 for a canal from Worsley to Manchester, he engaged the services of James Brindley (1716–72), and the next few years saw the construction of the

Worsley to Manchester Canal with its famous Barton Aqueduct over the River Irwell, and also the Bridgewater Canal from Longford Bridge to the Mersey at Runcorn, by which craft could proceed from Manchester to Liverpool. While he exercised the greatest possible economy in his private affairs, the Duke spent some £220,000 on his canals, which, however, ultimately yielded an annual revenue of £80,000. The Bridgewater Canal was sold in 1887 to the Manchester Ship Canal Company for £1,710,000. The Duke died in London on March 8, 1803, and was buried in the family vault at Ashridge. The monument to which reference has been made now belongs to the National Trust.

### British Patents

WHILE the fifty-third Report of the Comptroller-General of the Patent Office (London: H.M. Stationery Office. *4d.* net) is of academic interest as reminding us of the diversity of modern scientific research, its tabular appendixes reveal a gradual change in the destination of patent grants which is of over-riding industrial importance to Great Britain. Of the grants made in 1933, the last year for which final figures are available, 9,000 were made to residents within the British Empire as against 8,100 to foreigners. The figures for applications made during last year show a drop in British applications of six per cent since 1933, while those from outside the Empire have increased more than seven per cent. On this basis, grants made directly to foreigners in respect of applications made in 1935 will clearly exceed those made to British subjects. When it is realised that 1,796 of the applications made in 1935 by residents in Great Britain were made on behalf of inventors residing abroad, it becomes clear that foreign patentees are well on the way to outnumbering Britishers. If figures for purely scientific inventions were available, they would probably be even more striking, and it is disquieting to realise that patentees with no real compulsion on them to manufacture in Great Britain are increasing rapidly; German applications, for example, increased from 4,050 in 1933 to 4,481 in 1935, while in the same time applications from the United States grew from 3,194 to 3,612, these two countries being responsible for well over sixty per cent of the total foreign applications. There were no requests made in 1935 for the grant of a compulsory licence, but there were 789 for indorsement of patents "Licences of Right". The report is silent as to the results of the experimental extension of the search recently introduced, but the proportion of patents granted to applications made is apparently unaffected by it. The office surplus of receipts for 1935 over expenditure was £232,307, and must surely be a record.

### Development of Rockets for High Altitude Exploration

OUR readers who are interested in the development of rocket propulsion, and may have read a review in NATURE of March 14 of a somewhat premature book on the possibilities of using rockets for interplanetary travel, will be glad to hear that an authoritative statement has been issued by the Smithsonian Institution concerning the researches carried out by Dr. Robert H. Goddard, who has been experimenting at Roswell, New Mexico. Dr. Goddard has produced a rocket weighing five pounds which is capable of developing 1,030 horse-power for a period of twenty seconds by the combustion of a mixture of gasolene and liquid oxygen. Difficulties were experienced with the steadiness of direction of the rocket, which is now controlled by gyroscopic means. So far, the rocket has not attained an altitude of more than 7,500 feet, but the altitude has been purposely limited for experimental reasons. It is hoped that it will be possible to develop rockets capable of carrying recording apparatus which will serve as scientific instruments for exploring the upper atmosphere. It is good to hear that such experiments are being carried out, and the sober objectivity of Dr. Goddard's work presents a sharp contrast to the unscientific imagination exhibited by those who seek to direct attention to the advent of interplanetary travel long before the preliminary investigations that might throw light upon its possibility or otherwise have been completed.

### Archæological Investigation in the Irish Free State

UNDER a scheme of the Irish Free State for the relief of unemployment, in 1935 excavations were carried out on eleven sites, those on five being in continuation of work initiated in 1934. The results for 1935 are summarised by Dr. S. P. O'Riordan of the National Museum of Ireland in *Discovery* of April. Sites partly examined in 1934 are described first. In a cairn near Baltinglass, Co. Wicklow, additional stones carved with spiral ornament were found, with sherds of bronze age pottery and evidence of cremated burials. At Agnaskeagh, Co. Louth, the second of a group of megalithic cairns was examined and evidence again found of association with Early Iron Age. There was a considerable amount of iron and a cremation in a Hallstatt urn against the collapsed slab of a burial chamber. The most important investigation, again producing surprising results, was that of the complicated series of earthworks at Cush, Co. Limerick. Corroboration of the previous season's results, dating ring-forts with souterrains back to Late Bronze Age, was found in the discovery that the fort containing the burials was not the earliest, but had been built later than that adjoining it, and further that occupation had continued over a long period. House sites, not yet clear in all detail, show the plan of a distinctive Irish house-type. At Dunshaughlin, Co. Meath, a crannog produced evidence of a much larger area for this early Christian site (8–10th centuries) than was previously thought. Enormous quantities of bones of wild and domestic animals were found. The monastic site of Gallen Offaly continued to produce important evidence for the evolution of Irish art. Burial mounds at Lug, near Tullamore, Carrowjames, Co. Mayo, and Pollacarragune, Co. Galway, produced interesting material of bronze and iron age date, including what is probably the finest known razor as regards decoration, from the last-named.

**Royal Loan to British Museum**

AMONG recent additions to the collections of the British Museum (Bloomsbury), it is announced, are three ancient gold ornaments which have been placed on permanent loan by the King. Not only are these of great archæological value, but also they have the added interest that they came into the possession of the Crown during the nineteenth century under the law of Treasure Trove. The oldest of the three, dating from about 1400 B.C., is a gold beaker with handle, standing about 3½ inches high, which was found in 1837, together with a bronze dagger and other objects, in a barrow at Rillaton Manor, Linkinhorne, Cornwall. Coming next in age is a gold torc of about the first century B.C., which is made of twisted strands of gold. It was found in Needwood Forest in 1848. The third exhibit is a pectoral cross and chain, known as the Clare reliquary, which was dug up at the site of Clare Castle, Suffolk, in 1866. It is of English workmanship of about A.D. 1400. It has a pearl in each angle, and is stippled with a representation of the crucifixion in front and a floral pattern behind. It still contains pieces of the True Cross and the Rock of Calvary.

**Iranian Studies**

OWING in great measure to the exhibitions of Persian and Chinese art, which have been held at the Royal Academy, interest in Asiatic art, once exclusively confined to scholars and connoisseurs, is steadily spreading to a wider circle of the public. Not merely does it take the form of purely æsthetic appreciation ; it is rather an avenue to understanding of the culture and outlook of peoples hitherto regarded as far removed in more than merely a geographical sense. In this movement, the acquisition for the nation of the Eumorfopoulos collection of Chinese and Far Eastern art, of which the exhibition at South Kensington is proving markedly successful, has been an added stimulus. While London awaits its museum of Asiatic art, any addition to the facilities for study of the cultural achievement of the East is deserving of every encouragement. On this ground at least, students and others will welcome the announcement that friends of Iran have founded a society for the study of Iranian art on the lines of the Société des Études Iraniennes of Paris. Among those who are taking an active part are Lord Lamington, Sir Denison Ross, Mr. Laurence Binyon, Mr. Leigh Ashton and Prof. D. Talbot Rice. Those who are interested in the work of the society may communicate with the secretaries, Mr. Basil Gray and Mr. S. F. Shademan, at 10 Prince's Gate, S.W.7.

**Applied Physics**

THE March issue of the *Review of Scientific Instruments* devotes eleven pages to a report of the meeting of the Advisory Council on Applied Physics of the American Institute of Physics held in Pittsburgh in November. The Council recommended that in the American Physical Society a Division of Applied Physics be formed under a special chairman and committee to arrange for papers on applied physics to be read and discussed and to direct the journal *Physics*. In the discussion on the training of physicists for industrial posts, it was pointed out that at most of the American universities the average graduate in physics "lacks practical sense and initiative" as compared with the chemist or engineer, and "is inclined to overemphasise theory, quantum physics and atom splitting". A demand was made that "the applied physics student should be required to study more chemistry" in order that the present belief "that it is easier to train a chemist in the physics he needs than it is to train a physicist in the chemistry he needs" may be eradicated. Like the engineer, the chemist and the metallurgist, he should have courses in the practical application of his knowledge. The Council further resolved that meetings be held to discuss the outstanding problems of each industry and that the desirability of preparing a book "Physics in Overalls" be considered.

**Lancashire and Cheshire Fauna**

THE twenty-first annual report of the Lancashire and Cheshire Fauna Committee deals chiefly with 1934 records, and in addition to adding 146 new records to their faunal lists and 44 to one county, there are species new to Britain and to science. Of the Micro-Lepidoptera, a species bred by F. N. Pierce and W. Mansbridge from alpaca wool and wrongly considered *Tinea merdella*, Staint, is now found to be new to science and is named *Tinea lanella*, Pierce and Metcalfe. *Scythris fallacella* is a small moth new to Britain from the north Lancashire limestone. The small pearl-bordered fritillary butterfly has reappeared in the Delamere Forest area of Cheshire after fifty years absence. Of Coleoptera, *Anthicus tobias*, Mars., previously recorded from India, Arabia, Mesopotamia and Turkey, and said to have been from rotten sacking in Kent previously, was found breeding in some numbers by Mr. H. Britten on the Manchester Corporation refuse dump. Fifteen new records of Mallophaga for the counties are added from studies of wild and domestic birds. Efforts are being made to find the Cooke collection of sawflies compiled in the area last century, in order to examine the material in the light of the committee's present knowledge of the Hymenoptera-Symphyta. Request is also made for shrews and bats for parasite study at the University of Manchester. The ornithological report for Lancashire and Cheshire includes little of wide interest compared to former years.

**Mining Research at Birmingham**

WE have received from the University of Birmingham the report on the work of the Mining Research Laboratory during the fifteen months to March 1935. The introduction explains how it is that the report ends with work done in March. The report especially discusses silicosis, pneumonoconiosis, etc., to which six pages out of twenty are devoted. Attention may be directed to the excellent article by Bax in Glückauf, page 1241, upon the methods used in combating silicosis in the Ruhr district. The report before us shows, like Mr. Bax's paper, that nothing definite is

yet known as to the causes of silicosis, etc. The suggestion is made that the incidence of silicosis may in large measure be due to the riding of men on 'spakes'. The essential thing is that up to the end of December 1934 there have been a great many deaths in the country from silicosis, of which more than 50 per cent have occurred in the anthracite area of South Wales. Other subjects treated in the report before us are underground illumination, utilisation of coal by converting coke oven gas into gas with high calorific value, the quantity of firedamp in coal seams as worked, the pressure not having been investigated, spontaneous combustion in coal mines, control of atmospheric conditions in hot and deep mines, whilst investigations connected with the Gresford disaster apparently have occupied a great deal of the time and energies of the Research Laboratory, of which the late Prof. J. S. Haldane was director.

### Land Utilisation Survey

THE fifth annual report of the Land Utilisation Survey of Britain has recently been published. It records the number of published sheets as thirty-two, with twenty more sheets scheduled for publication in the near future. The completed survey will comprise 235 sheets. Most of the field work has now been completed, but there are still gaps, notably in East Cornwall, Herefordshire, the West Riding and parts of Wales. It is planned to issue eventually eighty-seven county reports. These will analyse the distribution of each type of utilisation and, where information is available, compare to-day's conditions with those of the past. The utilisation of the land will be correlated with soil conditions. Each county report will be published at one shilling. It may be noted that the relevant maps have been called for by the Commissioner of the Special (Depressed) Areas in order to indicate what land is still available for settlement or development. The cost of publishing a sheet is roughly £100, and various county authorities and universities have made contributions to the sheets of their areas. In other cases the ordering of large numbers of sheets for educational purposes has enabled publication to take place. The director, Dr. Dudley Stamp, appeals for more help of this kind. The headquarters of the Survey is the London School of Economics, where offers of help should be addressed.

### Lasting Qualities of Printing Paper

THIRTY-THREE years ago the Carnegie Institution of Washington, after careful inquiry, decided that papers made of rags of the best grade gave the greatest promise of durability, and since then the more important books published by the Institution have been printed upon specially made all-rag paper (Carnegie Inst., Washington, Report of Editor of Division of Publications for year 1934–35, p. 371). Increasing costs of such paper, together with the fact that the supremacy of all-rag paper has been challenged, led to a new investigation, which has just been completed. The value of rag paper is confirmed, for all investigators agreed about its satisfactory behaviour over long periods, but attention is directed to factors other than quality which affect the lasting property of paper. For example, disintegration is hastened when paper is stored in atmospheres rendered acidic by the presence of sulphur dioxide. It is recommended that permanent records should be stored under controlled atmospheric conditions of 50 per cent relative humidity and 70°–75° F. temperature. It is doubtful if paper made from chemically treated wood fibres would stand as well, but the evidence is not strong enough to induce the Institute to cast aside its rags.

### Tests on Wood Boxes and Crates

THE United States Forest Products Laboratory has already undertaken detailed scientific and engineering tests on wood boxes and crates. Fibreboard boxes and other shipping containers are now to be subjected to similar tests, according to Science Service, of Washington, D.C. These latter now constitute business amounting to 165,000,000 dollars in the United States. It is said that these fibre boxes and containers are on a largely empirical basis, and the unavoidable losses are as yet unknown. The investigation will take place in the pulp and paper section of the Laboratory, since fibre box paper is largely made from waste, such as newsprint, in combination with new pulp. The strength tests of the paper will be carried out with the use of highly accurate scientific instruments. These include a Tuckerman optical strain gauge which, under rigidly controlled atmospheric humidity conditions, tells the degree of stiffness in small strips of paper. A tiny mirror, rotating as the paper is stretched, throws a beam of light on a small scale which indicates the amount of stretch. Strength formulæ so derived will be correlated with others obtained from tests on the strength of finished fibre boards, as well as others calculated from tests of completed boxes. A circular rotating drum will be used for tests on completed boxes, both full and empty; the drum when revolved jolts, drops, and slides boxes round in a fashion similar to the treatment they are subjected to in transit by rail, ship or lorry.

### Handbook of International Organisations

A RECORD of international organisations is kept by the Section of International Bureaux of the League of Nations, and is published as a half-yearly "Bulletin of Information on the Work of International Organisations", and collected and compressed in a "Handbook of International Organisations", of which the last Supplement is dated 1931. The information contained relates not to work organised by the League but to the voluntary international societies—"organisations internationales privées"—which exist outside the League, many of which are older than the League. They have an independent life of their own, but keep touch with the League. There appear to be certain features common to a number of these organisations and their conferences; for example, several of them feel the need of specialist international

(*Continued on p.* 821.)

# Supplement to "NATURE"

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## Northern Lights*


By Prof. A. S. Eve, C.B.E., F.R.S., emeritus professor of physics, McGill University, Montreal


### The Upper Air

DWELLERS in cities see little of the night sky; they are dazzled by street lights and advertising signs. Those who live in the country enjoy a greater privilege. Although London is nearer to the north pole than Montreal or Quebec, yet it is the people of Canada who more frequently see the glory of the Northern Lights. It is the distance from the magnetic axis of the earth that counts, and that axis meets the surface of the earth at the north magnetic pole, which is in the island of Boothia in Canada. According to Størmer, the region in the northern half of the earth where auroras are most prevalent is a broad circular belt which has its centre near Smith's Sound in north-western Greenland. The three main forms of display are the arc or arch, the curtains and the long streamers. The colour is commonly greenish white or greenish yellow, sometimes with an admixture of red or violet.

The first appearance of the aurora is sometimes a bright quiescent arch with its peak a few degrees west of due north. This may suddenly be followed with a host of streamers, like searchlights, but changing, flickering and dancing. This is rather frivolous behaviour, for the Eskimo believe that the lights are the spirits of their ancestors. At other times the display begins with nearly vertical curtains of light the folds of which keep changing in form. It is often a fascinating and resplendent spectacle, and it is pardonable if a word picture falls short of the reality. The drapery is usually to the north, spreading from east to west, but sometimes it appears quite overhead. Even so far south as the State of New York the curtain may sometimes be seen south of the zenith.

The altitudes of these displays have been skilfully measured in Norway by Størmer, with a number of observers connected by telephone, who took photographs at the same instant from different places (Fig. 1) at a measured number of miles apart. The photographs (Fig. 2) show the northern lights in each case with a background of the stars of the Great Bear, but owing to parallax the lights are seen in different positions relative to the stars on the different photographs. A simple calculation determines the altitude of the aurora. About 60 miles is the most common result, that is, 60 miles from the surface of the earth, not from the observer. Sometimes the tops of the streamers may be 250 miles above the earth, and I believe that the lowest determination is an altitude of

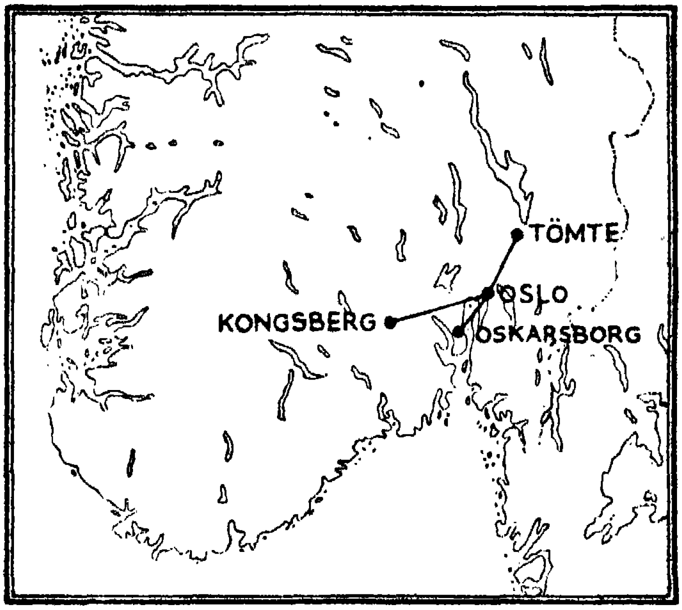


FIG. 1. FOUR STATIONS IN NORWAY SELECTED BY DR. CARL STØRMER AND CONNECTED BY TELEPHONE. FROM OSLO TO KONGSBERG IS 63 KM.

* From a Friday evening discourse at the Royal Institution on February 7.

40 miles. The record height for the top of a streamer is 1,000 kilometres, more than 600 miles. Similar measurements were made in Canada by Sir John McLennan and others, and the results there were in excellent agreement with the earlier determinations in Norway.

It is a strange fact, proved by Størmer, that those auroras which have the greatest altitudes, ranging (base to top) from 350 miles to 630 miles, occur in a *sunlit* portion of the atmosphere far above the dark region where the observer stands (*Science Review*, I, 3, 117, Feb. 1936). Those auroras which occur wholly in a dark atmosphere range from 60 miles to 200 miles. Thus the upper ionised atmosphere appears to expand by day and to shrink at night. Appleton has found similar results when measuring the altitudes of those ionised reflecting regions which echo back wireless waves of suitable wave-length.

Notwithstanding these definite facts, and the further one that Northern Lights appear behind distant mountains, there are many who declare that they have seen an aurora close to the ground. A probable, but not certain, explanation is that a patch of mist close to the ground was lit up by the vivid light of an aurora about 60 miles away*.

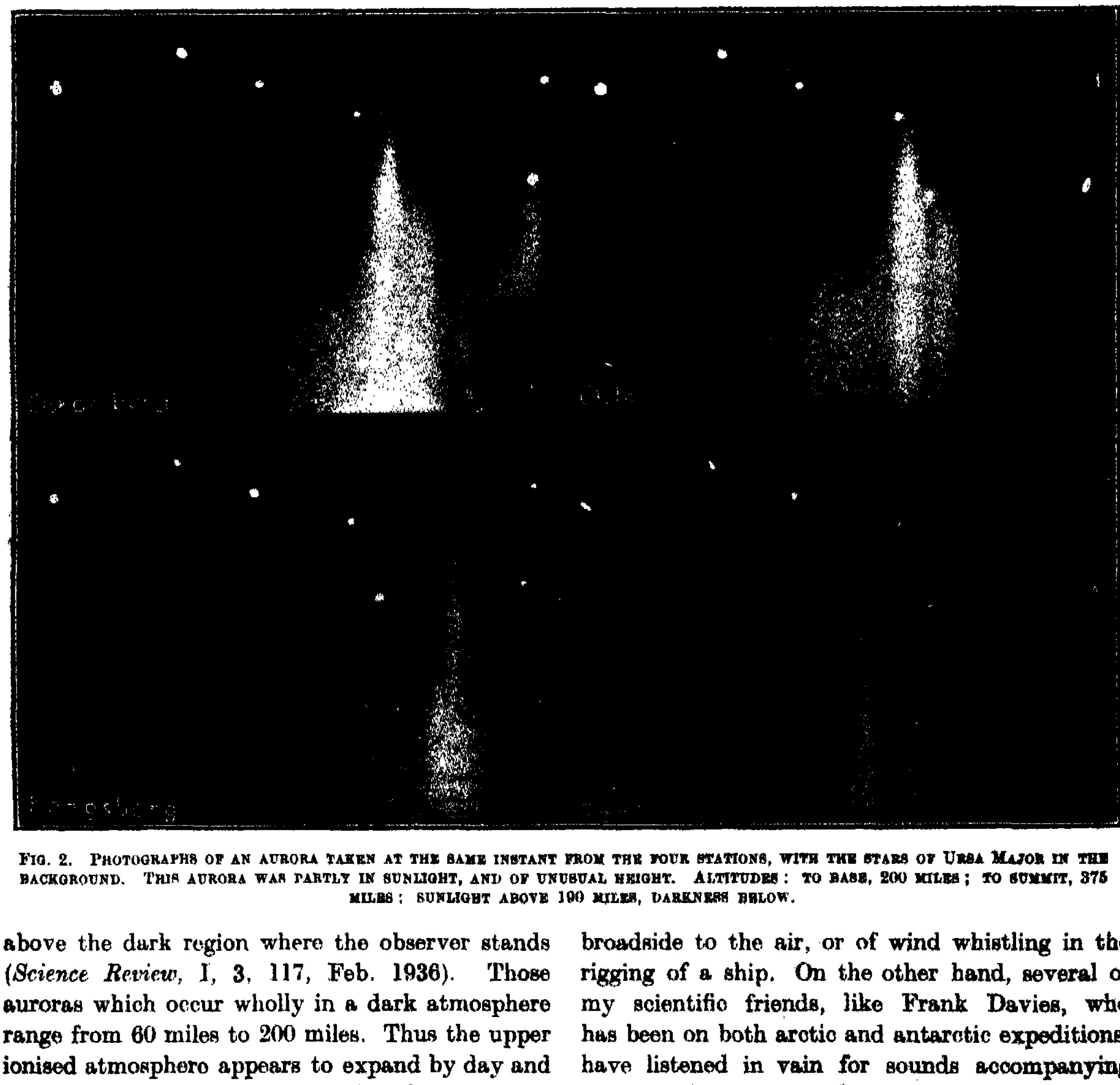

FIG. 2. PHOTOGRAPHS OF AN AURORA TAKEN AT THE SAME INSTANT FROM THE FOUR STATIONS, WITH THE STARS OF URSA MAJOR IN THE BACKGROUND. THIS AURORA WAS PARTLY IN SUNLIGHT, AND OF UNUSUAL HEIGHT. ALTITUDES: TO BASE, 200 MILES; TO SUMMIT, 375 MILES: SUNLIGHT ABOVE 190 MILES, DARKNESS BELOW.

### SOUND OF AURORAS

Several observers, some of whom I have met personally, declare that sometimes there occurs with an auroral display a sound, distinctly audible, that resembles the swish of a silk dress, or the noise of a sword moved swiftly with the blade broadside to the air, or of wind whistling in the rigging of a ship. On the other hand, several of my scientific friends, like Frank Davies, who has been on both arctic and antarctic expeditions, have listened in vain for sounds accompanying auroras. Negative evidence, however, is never satisfactory. Others declare that the noise swells and fades at the same instants that the lights increase and diminish in intensity. It is difficult to believe that this could be true. If the aurora is 60 miles away, the sound therefrom, if any, would take, at five seconds for each mile, about

* See "Low Auroras", by G. C. Simpson, *Quar. J. Roy. Meteor. Soc.*, 59, 185–190 (April 1933).

five minutes to arrive, so that coincidence would be more impossible than between lightning and thunder with a flash many miles away. Moreover, it must be remembered that sound does not emerge or travel at all well in highly rarefied air such as there is in auroral regions.

What then do these men hear ? It has even been suggested that they hear the blood surging in their head, or the tinkling of the ice of their frozen breath. We may safely dismiss these suggestions as trivial. It seems more probable that they hear something real in the same sense, let us say, as we hear church bells ring. I venture to suggest that in dry, cold weather there may be a small brush discharge from snow or bushes somewhat similar to St. Elmo's Fire, seen on mountains and sometimes as an electric discharge from the masts and rigging of a ship when the earth's voltage differs considerably from that of the air. My verdict, for what it is worth, is then that men cannot possibly hear the Northern Lights, which can make little or no noise, but they may hear something else not far from them, such as a local brush discharge.

### Spectroscopic Evidence

The spectrum of the aurora has been photographed, and most of the lines, or bands rather, are found to be due to nitrogen, which is the major constituent of the atmosphere (about four-fifths) here on the earth, and remains the chief constituent at great elevations. The spectrum of the aurora also includes the famous green line (Fig. 3) which Sir John McLennan investigated so ably and proved to be due to oxygen in an enhanced or unusual excited state. He and his co-workers actually produced the green line in his laboratory at Toronto by suitable stimulation of oxygen with helium, neon or argon also present. About one per cent of the air at ground-level is argon. All the other rare gases are present in much minuter quantities : neon, krypton, xenon, radon. Hydrogen is so light, and the molecular velocity in consequence so large, that the hydrogen overcomes gravity and passes out of the atmosphere.

Some of these gases, notably neon, the ingenious Claude has shown us how to collect, to place in tubes at low pressure, and to ionise with high voltage, so that every city is bespangled with artificial auroras and decorated with an extraordinary variety of coloured signs and vivid advertisements. The question is whether we most admire their scientific interest, their intrinsic beauty or the subtle skill with which they invite or induce the public to buy. It was supposed that some of the rare gases played a part in the rich colouring of auroras, and McLennan suggested that at high altitudes there is more helium than

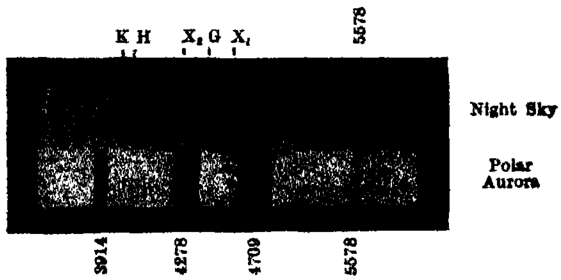


FIG. 3. A COMPARISON OF THE SPECTRA OF THE NIGHT-SKY AND OF AN AURORA, BY LORD RAYLEIGH. NOTE THE GREEN LINE DUE TO OXYGEN IN BOTH.

oxygen. On the other hand, experiments by Kaplan indicate that enhanced nitrogen can also stimulate oxygen to emit the light of the green line. Furthermore, the extended researches of Vegard show that the spectra of auroras contain lines or bands of nitrogen and oxygen only. No traces of hydrogen or helium were found.

### Aurora and Magnetism

Everyone to-day is familiar with a magnetic field, and most people also know something of the behaviour and properties of electrons. If you shoot electrons at right angles to a uniform magnetic field, the electrons will go round in circles—exact circles. The stronger the field and the slower the electrons, the smaller will be the circles ; and the converse is true. The mathematical, electrical and mechanical principles are simple and certain. If, on the other hand, electrons are projected obliquely to a magnetic field, then the electrons will each one describe a helix or a path with the shape of a corkscrew.

If the electrons are shot earthwards from the sun, they will travel through space and become entrapped by the magnetic field of the earth. They will spiral round the lines of force until they meet the upper atmosphere in the regions surrounding either the north or south magnetic poles. The speed of such electrons may be sufficient by their collisions to ionise the molecules, that is, to knock other electrons from them, thus leaving positively charged molecules, or ions. The recombination of electrons with positive ions is attended with radiation, as has been amply proved in laboratory experiments. It is generally believed

that electrons spiralling round in one direction arrive near the north magnetic pole and give rise by ionisation to the *aurora borealis*; while similar electrons spiralling round the lines of magnetic force in the other sense proceed towards the south magnetic pole and occasion the *aurora australis*. This result is well confirmed by experiment. It is not easy to ascertain the extent to which auroras occur together at the same time in both arctic and antarctic regions. There are some theoretical reasons for expecting such coincidence, and some of the major displays such as that of February 4, 1872, have been seen in both northern and southern latitudes.

There are some authorities who declare that light charged particles, such as electrons, would mutually repel one another on their long journey from the sun, so that they would be scattered far afield, and in that case there should be no auroras at all! Prof. S. Chapman states that there are positive, negative and neutral particles all coming from the sun. There is also quite a wide choice of possible projectiles—electrons, positrons, protons, neutrons, deutrons, alpha particles and cosmic rays, besides photons. Therefore it is not wise to be too didactic as to the nature of the bombardment that arrives at the earth's surface, but it is right to insist that only electrically charged particles will show so marked a tendency to proceed towards the two main magnetic poles of the earth.

It may very well be asked why it is claimed that the projectiles come from the sun. The answer is that auroras, sunspots and magnetic storms all follow, over a long series of years, the same periodic variation of increase and decrease in number and intensity. This is the well-known eleven-year cycle. In recent years the variation of the effective frequency required for radio signals across the Atlantic has been found to follow the same cycle. The general result is that we have a two-fold aspect of the sun. On one hand, it must be regarded as a variable star with an eleven-year period. On the other hand, it is endowed with such marvellous constancy that the main temperature of the earth has continued between the freezing and boiling points of water ever since life first appeared upon the earth many hundreds of millions of years ago, with every prospect of its long continuance. The sun converts some of its mass into radiation at the rate of three or four million tons a second, and yet plenty remains. This delicate balance of temperature must be an unusual feat, and is a thing which if it had not happened would be deemed, like a giraffe, impossible. In my young days, Sir George Stokes would have said, Design! To-day many say, Chance! Looking on the matter as fairly as I can, and not attaching too much weight to my enormous veneration of Stokes, it still seems to me that he was probably correct. This is a difficult question which everyone must decide for himself, unless he prefers to sit on the fence.

### Aurora and the Weather

There is a popular belief that a change of weather follows the Northern Lights—a change for the worse. There are many beliefs also connecting the moon and the weather; for if the moon is linked with the tides, why not with the weather? A glance at a large-scale map will show that many various types of weather, good, bad and indifferent, occur at any and the same time, at different places on the whole face of the earth, whereas the phase of the moon is the same for all. A somewhat similar statement may be made about an auroral display, which often covers a large region and has to be responsible for varied conditions. Besides, the aurora is 50 or 60 miles high, and our weather is brewed in the lowest ten miles, for the very highest cirrus clouds are rarely higher than six miles. There is, however, this point to be remembered. Northern Lights are not seen in cloudy weather, but only in clear. Hence it is much more probable that rain or cloud will follow the aurora than the reverse, but it is probably erroneous to state that the change was caused by the aurora.

### Exploring the Upper Atmosphere

To-day there are ten different ways of obtaining information about the nature and properties of the higher air (Fig. 4).

Pilot balloons filled with hydrogen can carry up small, light, ingenious recording devices. If the balloon is recovered on its return to earth there are records of elevation, temperature and humidity. Such balloons may also be followed with a transit instrument, or theodolite, so that the wind velocity at different levels may be deduced. The greatest elevation attained by a balloon, without recorders, was 23½ miles, at Padua. One of Regener's balloons has ascended 17½ miles and been recovered with its recorders.

The intrepid Piccard constructed a gondola sufficiently strong not to explode outwards, and was himself carried inside it by a balloon upwards. The ascent is easy. The place and nature of

return to the earth are largely fortuitous. He reached an altitude of 10 miles and obtained valuable results on the cosmic rays, which at that height are about 150 times as intense as on the earth's surface. The Soviet gondola crashed to disaster after attaining an altitude of 12 miles. The greatest height so far attained is 13½ miles, achieved last year by Anderson and Stevens in the United States.

A new method of exploration has recently been devised by Tuve and others, members of the Department of Terrestrial Magnetism, Carnegie Institution of Washington. A searchlight beam is directed upwards to a height of 17–40 miles, and the intensity of the light is modulated, or varied periodically at the source. A large concave mirror collects the scattered light from the upper part of the beam and brings it to a focus on a photo-cell connected to an amplifier, which is synchronised with the modulation of the searchlight. This apparatus may well give some information on the nature of the molecules in those very regions on which we are least informed, above the range of pilot balloons and below the auroral and ozone layers.

Ozone, $O_3$, is produced from oxygen, $O_2$, by radiations of a suitable frequency or by electrical discharges. Much of the ultra-violet light from the sun is absorbed or stopped in the ozonosphere about 20–40 miles above the earth. The presence of the ozone is revealed by absorption bands in the spectrum of the sun. When the sun is high it passes almost vertically through the ozone layer. When the sun is setting its rays have to pass horizontally through a much greater thickness. Measurements of the intensities of the absorption lines due to ozone lead to an estimate of the height of the ozone region—about 25 miles, and thus lower than the Northern Lights.

The barometric disturbance due to the great Krakatoa volcanic explosion travelled four times round the earth, and the actual noise of it was heard 3,000 miles away. The sound of big guns or of heavy explosions passes upwards into the cool and rarefied air and is then refracted or bent back again to the earth, so that sometimes, like short-wave radio, it cannot be heard or detected at intermediate distances. Newton stood in the gateway of Trinity College, Cambridge, and heard the guns of a naval action between Dutch and English. He foretold a British victory because the noise of battle became gradually fainter as the victors pursued the Dutch. The fact that sounds are bent back again to the earth necessitates a warmer layer above the cold. It seems that with increasing altitude the temperature may gradually decrease down to many degrees below zero Fahrenheit; but at a height of 30 miles there is an increase to 80° F., and the heat to maintain this may be connected with the formation of ozone from oxygen by the sun's ultra-violet light.

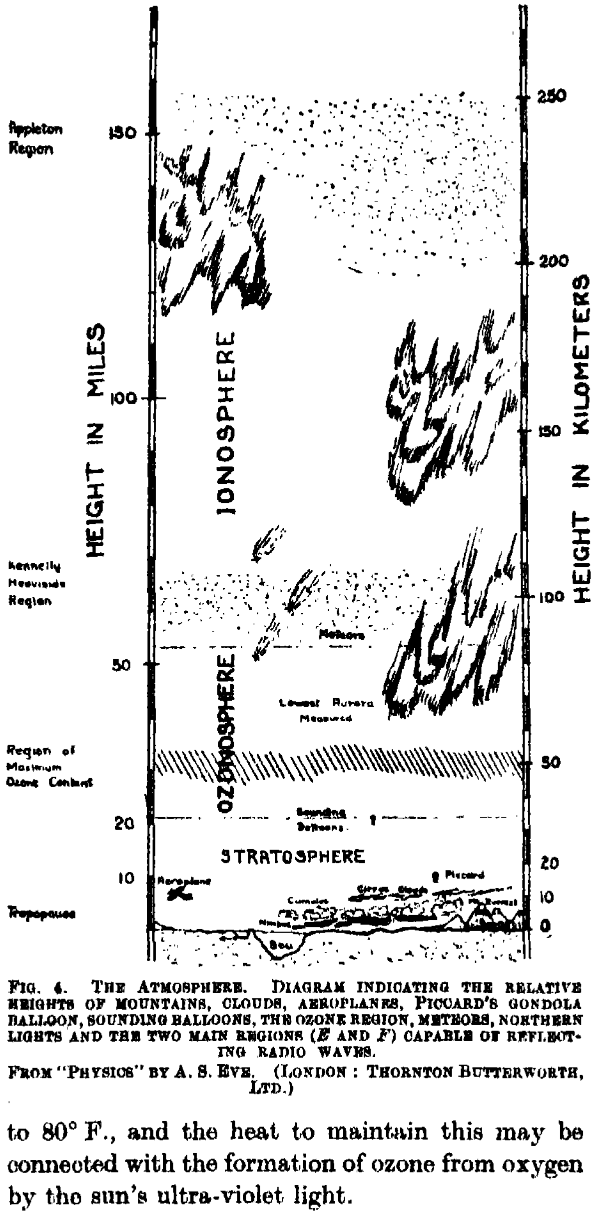


FIG. 4. THE ATMOSPHERE. DIAGRAM INDICATING THE RELATIVE HEIGHTS OF MOUNTAINS, CLOUDS, AEROPLANES, PICCARD'S GONDOLA BALLOON, SOUNDING BALLOONS, THE OZONE REGION, METEORS, NORTHERN LIGHTS AND THE TWO MAIN REGIONS ($E$ AND $F$) CAPABLE OF REFLECTING RADIO WAVES.
FROM "PHYSICS" BY A. S. EVE. (LONDON: THORNTON BUTTERWORTH, LTD.)

### RADIO WAVES

The most important method of throwing light on the nature of the upper regions of the air is by projecting radio (or wireless) waves directly upwards, for it is found that with suitable frequencies they will be reflected back to the earth again. Some will recall how puzzling it was, in the early days of wireless, to account for the fact that the electromagnetic waves, expected to move in a straight line like light, could travel from Ireland

to Newfoundland. To-day wireless waves, carrying speech, music or Morse, can be sent completely round the world, so that a man can speak to himself and hear it a fraction of a second later, using waves which have circumnavigated the globe, changing local time in the most remarkable way as they travelled. During a part of the journey it must have been yesterday, or to-morrow, though on return it was the same day and perhaps about a seventh of a second since they started. It was surmised both by Kennelly and by Heaviside independently that the possibility of successful long-range wireless signals depended upon reflection or refraction by an electrified or ionised region at a considerable height above the earth. The proof of the existence of such a conducting region was given by Appleton, who showed that there is another higher region also capable of reflecting radio waves back to the earth.

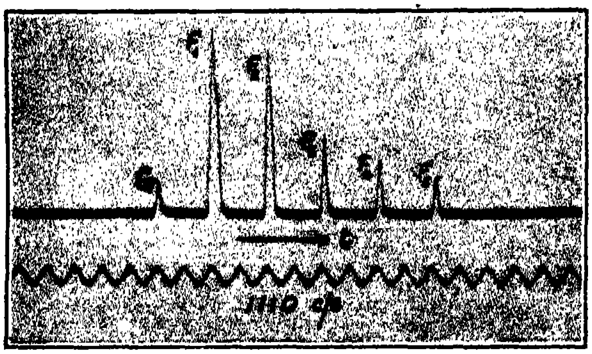

Fig. 5. Reflections of radio-waves from the Appleton or $F$ region. $G$ is the ground or original signal. $F_1$, $F_2$, $F_3$ . . . are successive signals echoed from the stated region or after repeated reflections from ground and ceiling.

The lower or $E$ region is at about 100 kilometres, or 60 miles, from the earth, and it is also called the Kennelly-Heaviside region. The upper or $F$ region is two or three times as high and bears the name of Appleton. It is possible to send a brief signal of suitable frequency which will be reflected back from both the $E$ and $F$ regions, so that both signals may be recorded on a suitable photographic plate (Figs. 5, 6) by means of the cathode ray oscillograph. It is possible to measure the very short period of time between the initial and return signals, and as the velocity of such waves is about 186,000 miles a second, it is easy to deduce the height of the reflecting region. For example, if the interval is one thousandth of a second, the reflecting layer would be about 93 miles above the earth. Experiments carried out by Henderson and others, during a total eclipse of the sun in Canada, proved that the $E$ region is made conducting, or is ionised, by the ultra-violet light from the sun, but it is not yet possible to assign a cause to the $F$ region.

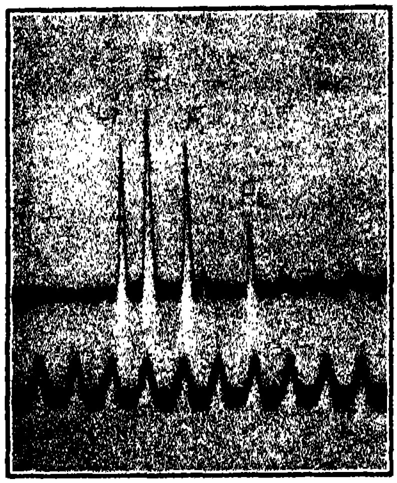

Fig. 6. There are echoes shown from both $E$ and $F$ regions. The lower curve gives a time-scale of 1,110 cycles a second. Figs. 5 and 6 are due to the courtesy of Prof. E. V. Appleton.

It should be now clear that it is necessary to determine in due course the different types of radiation responsible for (*a*) the ozone layer, (*b*) the Kennelly-Heaviside layer, (*c*) the Appleton layer, (*d*) the more occasional and local auroral displays, all of which are attributable to the sun's activity. There is a yet more difficult problem with respect to the cosmic rays and the bursts or

Fig. 7. Four stages of the solar activity, taken in calcium light at Mount Wilson Observatory. (Eleven-year cycle, from left to right—first quarter, full, waning, clear.)

showers of ions to which they give rise. Sometimes a hundred million ions occur at a single outburst.

In the upper atmosphere, the pressure is so low that the molecules are quite far apart, and if an electron is detached from a molecule by some type of radiation, it may have to wander a long way before it can find a partner in a positive ion; or it may find a resting place on a neutral molecule, so that the pair become a negative ion. While free, the electrons are so small and light, compared with their electric charge, that they are readily made to oscillate, or dance in rhythm, with any electromagnetic waves that are passing them. Curiously enough, the group of waves travels the *faster* in consequence, so that an electromagnetic wave entering these ionised regions obliquely has the upper part wheeling faster than the lower, until the wave front is turned round and proceeds downwards to the earth again. However, much the same sort of thing happens every time you look into an ordinary mirror or looking-glass. There also the free electrons in the mercury at the back of the glass are able by their stimulated motion to return to you a fairly faithful image of your face.

Radio signals will also bounce to and fro between the earth and the reflecting regions, proving that the earth is an admirable radio reflector. The total path for eight such reflections, which have been obtained from the *F* region, must exceed 2,000 miles.

### Sunspots

In old days the heavens were deemed to be eternal, changeless and perfect, so that the discovery in the days of Galileo that there were spots on the sun came as a shock to medieval thought. The face of the sun is a turbulent place at the high temperature of 6,000° C. Black spots appear on it, sometimes large enough to be seen through a darkened glass with the unaided eye, and broader than the diameter of the earth. The number of these spots follows the same eleven-year cycle as the frequency of the aurora. At the beginning of such a period the face of the sun may be practically without spots. In due course a few appear in middle latitudes on both sides of the sun's equator. There is a steady increase in number, the spots become nearer the equator, and they disappear when at the lowest attained latitudes (Fig. 7).

These relatively cool dark whirlwinds reveal magnetic properties discovered by Hale through the Zeeman effect, and they may perhaps be compared with the 'lows' or cyclones which often bring storm, rain and flood. The periodicity of sunspots, auroras, magnetic storms on the earth, and changing radio phenomena has been found to hold good for the fluctuations of the white polar caps on the planet Mars, and even for a cycle of ring growths in the great and ancient trees of western America.

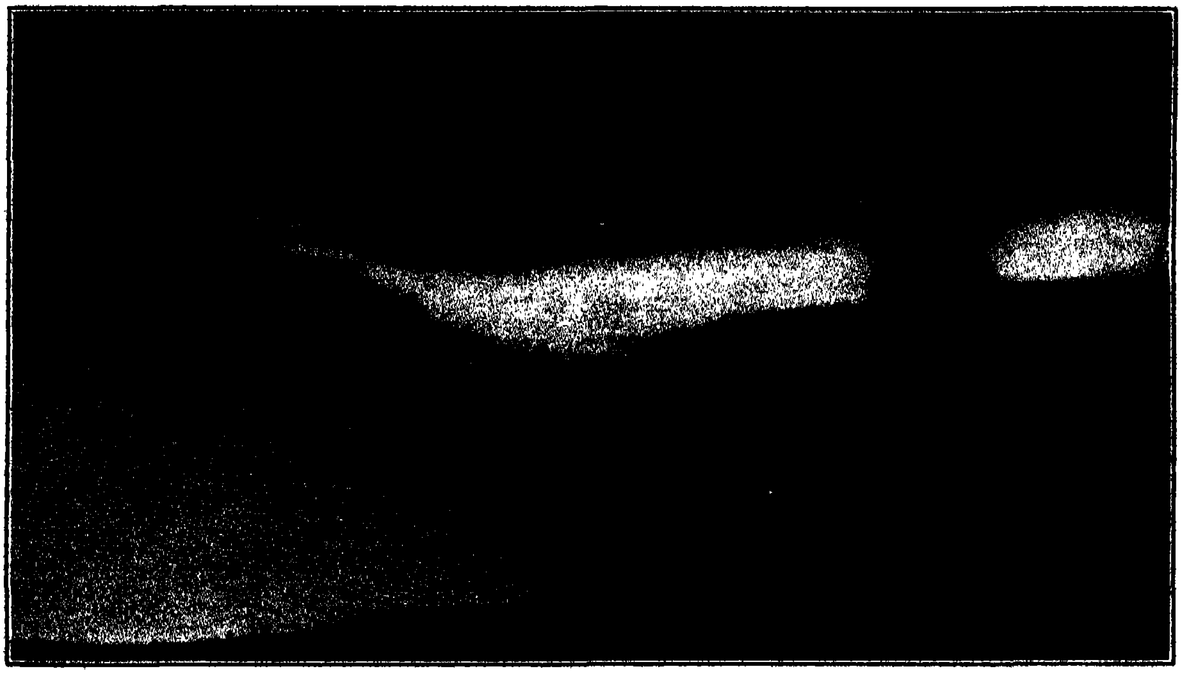

FIG. 8. MOTHER-OF-PEARL CLOUD, ABOUT 15 MILES HIGH. NORWAY, JANUARY 29, 1932. (BY COURTESY OF DR. CARL STØRMER.)

### METEORS

Most people are familiar with shooting stars or meteors and many have seen in their lives dozens or hundreds of them; yet it always comes as a surprise to learn that no less than 20 million of them every day plunge into our atmosphere with velocities ranging up to 130 miles a second. Sometimes these visitors are but the size of a pin's head, and at other times they are large enough to pierce the atmosphere and reach the earth. The famous Arizona crater may have been formed long ago by a giant meteor; the crater is 1,400 yards wide and more than 500 feet deep. In 1908, a great meteor, estimated to weigh 130 tons, fell in Siberia and devastated by its great heat hundreds of square miles of country. The elevation of most frequent meteoric displays is about 40–60 miles above the earth. It is somewhere in this region that the temperature rises according to the theory of the reflection of sound waves, to which already reference has been made. Sometimes the meteors are of iron, sometimes of stone, and it is not easy to understand how they become red or white hot when rushing through cool air, how indeed they acquire more heat from the bombardment of molecules than is carried away by them. However, the luminosity of meteors occurs in *rarefied* air at heights of 100–30 miles above the earth. An experiment in the laboratory of a similar character would be difficult to make, because our projectiles achieve a speed of a few thousand feet a second as contrasted with meteors having velocities of many miles a second.

### MOTHER-OF-PEARL AND NOCTILUCENT CLOUDS

There occur rarely and at great elevations iridescent clouds, as remarkable for their beauty as for their height. They are generally observed over regions of low barometric pressure and it is probable that the clouds are formed of super-cooled water vapour (S. Chapman, NATURE, 129, 497, April 2, 1932). Størmer and his co-workers have measured the altitudes of many of these 'mother-of-pearl' clouds (Fig. 8) and found them to be in the stratosphere, about 15 miles above the ground.

FIG. 9. LUMINOUS NIGHT CLOUDS. ALTITUDE, 50 MILES. PHOTOGRAPHED AT DRÖBAK, SOUTH OF OSLO, MIDNIGHT, JULY 27–28 1909. BY COURTESY OF DR. CARL STØRMER.

The strangest of clouds (Fig. 9) are those observed in the middle of the night, or twilight, which occur at a measured altitude of 50 miles! The heights have been measured in Norway (Carl Størmer, *Astrophysica Norvegica*, I, 3, Feb. 1935) by the same band of observers and at many of the same stations as those used in the determination of the distance of auroras from the earth's surface. These clouds are not iridescent, and they move westwards at about a hundred miles an hour!

It will be gathered that the study of the Northern Lights is bound up with other physical phenomena in the upper regions of our atmosphere, and that progress can best be made, as in other branches of science, by advance on a broad front.

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vocabularies of their own. At many of the conferences, League of Nations representatives have been present. More and more the conferences are grouping themselves, and many conferences are being attended by representatives of other conferences. Such groups are the educational, agricultural and economic conferences. For example, the "Liaison Committee of Major International Associations" represents more than twenty-four international organisations, mostly educational. The economic conferences are not under the dictation of Governments. Between them these societies are working out a world-policy which is years ahead of the present League of Nations. The number of societies is increasing, and they are increasingly specialised. The International Council of Scientific Unions does not cover everything, although it is an authorised channel of communications. New societies of all sorts keep on appearing. All this apparatus of voluntary societies may be thought of as advisory to the official governmental League of Nations. Possibly it is more important that the politicians should listen to the scientific workers, rather than that the latter should let themselves be entangled in political machinations.

### Fig Mosaic

A LEAF-MOTTLING disease of the fig has been described from California and from Australia. The malady is caused by a virus, and is known as fig mosaic. Dr. G. C. Ainsworth announces the appearance of the disease in England (*J. Roy. Hort. Soc.*, December 1935), and mentions two types of mottling, namely, irregular, yellowish-green blotches, and pale green spots or bands along the larger veins. The fruit is affected but slightly, with small spots. Now that botanists are 'virus-conscious', it has been realised that the disease was known twenty years ago, though its cause was not suspected, and it is fairly widespread in Great Britain.

### England to Cape Flight

Mrs. Mollison arrived in Cape Town at 3.30 British Summer Time on May 7, having completed a flight from England in 3 days 6 hr. 25 min. This time is a little more than eleven hours better than the previous record set up by Flight Lieutenant Rose, and represents a noteworthy achievement as regards endurance of both pilot and aeroplane. Mrs. Mollison flew over the West Coast route in Africa, and her machine was a Percival Gull with a Gipsy Six (120 h.p.) engine. It is stated in *The Times* that the distance covered was about 6,200 miles, with 43 hours flying and 36 hours on the ground. At the time of writing, Mrs. Mollison is well started on the return journey, but following the East Coast route.

### Institution of Electrical Engineers' Awards

THE following awards of the Institution of Electrical Engineers have recently been made for papers read during 1935–36, or accepted for publication: Institution Premium to W. L. McPherson and E. H. Ullrich; Ayrton Premium to Mr. G. H. Wilson, Lieut.-Commander E. L. Damant, and Mr. J. M. Waldram; Fahie Premium to Major L. H. Peter; John Hopkinson Premium to D. R. Davies and C. H. Flurscheim; Kelvin Premium to Dr. T. E. Allibone and F. R. Perry; Overseas Premiums to Dr. J. J. Rudra and D. J. Badkas, J. H. Sprawson and T. Varney; Extra Premiums to G. A. Whipple, A. L. Whiteley, Dr. Russell J. Reynolds, E. R. Kaan, B. G. Gates, E. T. Hippisley, A. C. Timmis, and Mr. R. Poole. *Wireless Section:* Duddell Premium to H. L. Kirke and A. B. Howe; Extra Premiums to W. J. Brown and E. B. Moullin. *Meter and Instrument Section:* Silvanus Thompson Premium to J. H. Buchanan; Extra Premiums to Prof. J. T. MacGregor-Morris and R. M. Billington, J. S. Preston and G. A. Burns and T. R. Rayner. *Transmission Section:* Sebastian de Ferranti Premium to Mr. D. Ross; Extra Premium to Mr. J. S. Forrest.

### Conferences on Spectroscopy and Colour

THE Massachusetts Institute of Technology has recently announced a special summer programme on applied physics, in connexion with which a conference on spectroscopy and its applications will be held on July 20–22, and a conference on colour on July 23–25. The former conference will include discussions on spectroscopic analysis of materials, and on other applications of spectroscopy to biology, medicine, chemistry, metallurgy, mineralogy and to industrial and engineering problems; the latter will include spectrophotometry, colorimetry, and the applications of colour measurements to industrial problems. Detailed consideration will be given to the behaviour and control of the colour of dyes and pigments, and their application in such fields as the paint, ink, paper, textile and ceramics industries. These conferences come at the conclusion of the courses on spectroscopic analysis of materials which are being given at the Institute during the six weeks from June 16 until July 24. There is no charge for attendance at the meetings of the conferences, copies of the detailed programmes of which will be sent on application to Prof. G. R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

### Announcements

MR. C. H. WADDINGTON, of the Strangeways Research Laboratory, and of the sub-department of experimental zoology of the University of Cambridge, has been awarded the Albert Brachet prize of the Royal Academy of Belgium for his experiments on chicken embryos. This was the first award of the prize, which is given for the best work in embryology published in French, German, English, Italian or Dutch over a three-year period.

THE field plots and laboratories of the Rothamsted Experimental Station, Harpenden, will be opened for inspection (by invitation) on June 11, at 11.15 a.m. The Right Hon. J. Ramsay Macdonald will be present.

THE Association of Scientific Workers has arranged a public meeting on the "Utilisation of Science" to be held on Friday, May 22, at University College, London, at 8 p.m. The speakers include Prof. P. M. S. Blackett, Dr. J. Needham and Dr. J. D. Bernal.

THE forty-first Annual Congress of the South-Eastern Union of Scientific Societies will be held at Oxford on June 30–July 4. The president-elect of the Congress is Prof. G. D. Hale Carpenter, who will deliver the presidential address entitled "Charles Darwin and Entomology" on June 30. Further information can be obtained from the honorary general secretary, Mr. E. A. Martin, 14 High View Close, Norwood, S.E.19.

THE National Baby Week Council is arranging a National Baby Week to be held on July 1–7. The special subjects of propaganda this year are (1) maternal welfare, stressing the constructive aspects as distinct from maternal mortality, disease and morbidity, and (2) the question whether all is being done, nationally and locally, for the welfare of the child of 2–5 years of age. Further information can be obtained from the Secretary, National Baby Week Council, 117 Piccadilly, London, W.1.

A SHORT course in genetics, cytology and plant biochemistry will be held at the John Innes Horticultural Institution, Mostyn Road, Merton Park, London, S.W.19, on July 13–25. It is expected that the following will lecture: Sir Daniel Hall, Prof. J. B. S. Haldane, Dr. C. D. Darlington, Mr. M. B. Crane, Dr. R. Scott-Moncrieff, Dr. F. G. Brieger and Dr. K. Mather. The course will be open to university and research station staffs and post-graduate students. No fee will be charged. The names of those who desire to take part should be sent in good time to the Librarian at the Institution.

THE twenty-fifth Congress of the Italian Society for the Progress of Science will be held this autumn at Tripoli, under the presidency of Marshal Balbo, Governor of Libya.

AT the suggestion of the Touring Club de France, the Paris Academy of Medicine has appointed a committee to inquire what steps can be taken to support the campaign against noise.

AN International Congress of Medical Motorists will be held in Paris on June 14–16. Further information can be obtained from the Association des médecins Automobilistes de France, Boulevard Magenta 60, Paris.

THE second Congress of the International Association for the Study of Solar, Terrestrial and Cosmic Radiations will be held at La Malou (Hérault) on July 15–17, when papers will be read on solar electrical radiations, atmospheric electricity and ionisation of the air and the radioactivity of rocks and wells. Further information can be obtained from the secretary of the Association, 24 rue Verdi, Nice.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant (Grade III) at the Chemical Research Laboratory, Teddington—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 19).

A junior assistant in the Ballistics Department of the Research Department, Royal Arsenal, Woolwich, S.E.18—The Chief Superintendent (May 19).

A teacher of domestic subjects and a lecturer in mechanical engineering in the Central Technical College, Suffolk Street, Birmingham, 1—The Chief Education Officer (May 27).

A sub-assistant in the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (May 28).

A lecturer and two demonstrators in physiology in the University of Liverpool—The Registrar (May 29).

A teacher of mathematics in the Northern Polytechnic, Holloway, London, N.7—The Clerk (May 29).

A lecturer in physics in the Polytechnic, Regent Street, London, W.1—The Director of Education (May 29).

A demonstrator in zoology in the University of Bristol—The Registrar (May 30).

A regius professor of practice of medicine in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (May 30).

A professor of mathematics in the Queen's University of Belfast—The Secretary (May 30).

Five assistant veterinary officers to the Essex County Council—The Clerk to the County Council, County Hall, Chelmsford (May 30).

A lecturer in the Civil and Mechanical Engineering Department and a lecturer in charge of instruction in instrument making in the Northampton Polytechnic, St. John Street, London, E.C.1 (May 31).

A lecturer in physical chemistry in University College, Bangor—The Registrar (June 6).

An assistant (Grade III) in the Admiralty Scientific and Technical Pools (chemistry and metal analysis)—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (quote C.E. 2659/36) (June 6).

An assistant lecturer in botany and an assistant lecturer in metallurgy in University College, Swansea—The Registrar (June 6).

A junior assistant physicist in the Royal Cancer Hospital (Free), Fulham Road, London, S.W.3—The Secretary (June 15).

A regius professor of astronomy in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (June 30).

A superintending engineer and constructor of shipping in the Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London (August 1).

Research assistants in applied mechanics or experimental physics and a research assistant of the Silk Section of the British Cotton Industry Research Association, Shirley Institute, Didsbury—The Director.

An instructor in commercial fruit growing in the Kent Farm Institute—The Agricultural Organiser, Springfield, Maidstone.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 831.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## The Nature of Light

OBJECTIONS to the views expressed in my communication[1] on this subject have been brought forward by Mr. C. Hurst[2] and Dr. N. S. Japolski[3].

In reply to Mr. Hurst, I would point out that the flow of energy outside the core of the quantum is in the direction of propagation of the light and is proportional to $\cos^2(pt-mz)$; thus it is always positive, and the flow will be always in one direction. Inside the core where there is a longitudinal magnetic force, there is a flow of energy at right angles to the axis, but this is proportional to $\cos(pt-mz)\sin(pt-mz)$; the average of this both with regard to time and space is zero. Thus, and this is I think the point Mr. Hurst has overlooked, at any time the energy flowing out at one place will be equal to that flowing inward at the same time at a place a quarter of a wave-length from it, and at any point the quantity flowing in will be the same as that flowing out a quarter of a period later, so that the quantum does not lose any energy by this process.

Dr. Japolski, who has made very thorough and extensive researches on the mathematical theory of cylindrical waves, raises the objection that a quantum of the kind I suggest would require a wire of infinite specific inductive capacity to guide it. I do not agree with this. I think a quantum which has its distribution of electric and magnetic forces such that the momentum is all in the direction of propagation of the light would not require any guidance after leaving its source. Whether a system of this kind could be emitted by a luminous atom or not depends upon the mechanism of that emission, a subject about which very little is known; what is known does not seem to me to make it impossible or even very improbable. Two difficulties which suggest themselves at once are first, that the wave-length of light is enormously greater than the linear dimensions of the atom which emits it, more than a thousand times greater if the dimension of the atom is taken to be $10^{-8}$ cm.; and secondly, why the radiation is concentrated in one direction.

With regard to the first point. We must remember that the conditions inside the atom when it is emitting light are very different from those in the ether. During the emission of the light, there is an electron returning to the place from which it or another electron has been ejected, which before it settles down will oscillate about this place with a definite period. The optical properties of an atom which contains an electron with a free period ($n$) have been worked out in connexion with the theory of 'anomalous dispersion', and it has been shown that if $V$ is the velocity of light of frequency $p$ through the atom and $c$ that through the ether,

$$\frac{c^2}{V^2} = 1 + \frac{A.n^2}{n^2 - p^2}$$

Thus if $p = n(1-\alpha)$, where $\alpha$ is a small positive quantity, $V$ must be very small compared with $c$, so that the wave-length of the light in the atom will be very much smaller than when it is in the ether.

Next with regard to the concentration of the radiation in a definite direction. If as seems plausible the light is due to the vibrations of an electron inside the atom, then if these vibrations were in a straight line Hertz's solution of the waves produced by a bi-pole whose moment varies harmonically shows that the radiation at a great distance from the atom would be divergent waves spreading out from the atom as centre; the flow of energy in a direction making an angle $\theta$ with the path of the electron would be proportional to $\sin^2\theta$; there would thus be continual loss of energy and no concentration. It is, however, very generally believed that there are very strong magnetic forces inside the atom; if so, the paths of the electrons in the atoms will not be straight lines, for the electrons will be twisted round the lines of magnetic force and will describe spirals whose axes are parallel to the magnetic force. If this force is nearly at right angles to a stream of electrons and is above a certain intensity, the paths of the electrons will be spirals whose turns are nearly at right angles to the force.

The stream of electrons is equivalent to an electric current and will produce much the same electric and magnetic fields as would be produced by an alternating electric current flowing through a solenoid which coincided in position with the spirals described by the electrons. These currents would produce an alternating magnetic force inside the solenoid parallel to its axis, the magnitude of which would not vary over its cross-section, and there would be no longitudinal magnetic force outside the cross-section. This agrees with the solution given in my letter, if $a$ be taken as the radius of the solenoid. The same number of lines of magnetic force will pass through any circle outside the solenoid if its centre is on the axis and its plane at right angles to it. Thus the electromotive force round the circle due to the alteration in the magnetic force will be constant, whatever is the radius of the circle, and therefore the tangential electric force will be inversely proportioned to the radius. If the circle is inside the solenoid, the number of lines of force passing through it will be proportional to $\pi r^2$, if $r$ be the radius, and therefore the

tangential electric force will be proportional to $r$; both these results are in accordance with the solution.

On this view the formation of the light quantum and its guidance is due to the magnetic force inside the atom. After it has been started on the way it should go, it will continue on that way without further guidance. A bullet has to be guided by the barrel of the rifle, but it is not necessary for the barrel to extend to the target.

J. J. THOMSON.

Trinity Lodge,
Cambridge.
April 21.

[1] NATURE, 137, 232, Feb. 8, 1936.
[2] NATURE, 137, 582, April 4, 1936
[3] NATURE, 137, 663, April 18, 1936.

## Phenomenological Theory of Supra-conductivity

THE latest version[1] of F. and H. London's phenomenological theory of supra-conductivity (which on its first appearance[2] was obscured by an erroneous assumption as regards the boundary conditions[3]) can be put into a very simple form. We assume Maxwell's equations for a medium with dielectric constant $\varepsilon$ and permeability 1 (choosing the units so as to make $c = 1$ and abolish odious $4\pi$'s):

$$\left.\begin{array}{l}\operatorname{curl} E = -\dot{H} \\ \operatorname{div} H = 0\end{array}\right\} (A) \qquad \operatorname{curl} H = \varepsilon\dot{E} + I \quad (B)$$

In empty space, $I = 0$. In a normally conducting metal there is a current of conduction $I_c$ in addition to the displacement current $\varepsilon\dot{E}$:

$$I = I_c = \sigma E. \qquad (C)$$

The assumption for the supra-conductor is, that

$$I = I_c + I_s = \sigma E + I_s.$$

That is to say, there is a *third* sort of current $I_s$, call it the *supra-current*, which either is added to, or (if $\sigma = 0$) replaces the ordinary conduction current $I_c$.

$I_s$ cannot be given in quite so simple a way as $I_c$, yet there is a certain *analogy* with the first two types of current. Let us introduce, just for the moment, the sign $I_d = \varepsilon\dot{E}$ for the displacement current. Then from $(A)$

$$\operatorname{curl} \frac{I_d}{\varepsilon} = -\ddot{H}\ ,\ \frac{\dot{I}_d}{\varepsilon} = \ddot{E}\ ; \qquad (D'')$$

and from $(A)$ and $(C)$

$$\operatorname{curl} \frac{I_c}{\sigma} = -\dot{H}\ ,\ \frac{\dot{I}_c}{\sigma} = \dot{E}. \qquad (D')$$

The *new* assumption with respect to $I_s$ is,

$$\operatorname{curl} \Lambda I_s = -H\ ,\ \Lambda\dot{I}_s = E, \qquad (D)$$

$\Lambda$ being a constant of the material, like $\varepsilon^{-1}$ and $\sigma^{-1}$. The analogy is conspicuous. $\Lambda$ might be called the constant of supra-conductivity.

The equations $(D)$ would seem rather abundant for the only purpose of introducing the third type of current. But they contain $(A)$, which therefore can be dropped. So the *full* system of equations for the supra-conductor read

$$\operatorname{curl} H = \varepsilon\dot{E} + I \qquad \begin{array}{c}\operatorname{curl} \Lambda(I - \sigma E) = -H \\ \Lambda(\dot{I} - \sigma\dot{E}) = E.\end{array} \quad (1)$$

Thus there are nine equations for the nine vector components of $E$, $H$, $I$. As to the surfaces of discontinuity, the well-known limiting conditions of Maxwell's theory ($E_{\parallel}$, $H_{\parallel}$, $(\varepsilon\dot{E} + I)_{\perp}$, $H_{\perp}$ continuous) have, of course, to be retained. In addition, the second curl-equation of (1) requires the continuity of $\Lambda(I - \sigma E)_{\parallel}$ at the surface between two different supra-conductors. (The parallel component of supra-current will therefore have a discontinuity.)

The natural *problem of initial values* for the supra-conductor would be to give oneself $E$ and $I$. Equations (1) then determine the future development uniquely. If, alternatively, $E$, $H$ are to be given, one has to take care to choose $H$ solenoidal (div $H = 0$), but in addition a curl-free part of $\Lambda I$ remains arbitrary.

The equations containing $\Lambda$ may be taken to state that the negative of the product $\Lambda$ by supra-current is a suitable vector potential to represent the $E$, $H$-field within every coherent supra-conducting region, the scalar potential being zero. From here the theory of integration is easily developed. We shall only observe, that for the density $\rho = \varepsilon \operatorname{div} E$ we get the equation

$$\ddot{\rho} + \sigma\dot{\rho} + \Lambda^{-1}\rho = 0, \qquad (2)$$

which amounts virtually to $\rho = 0$ always and everywhere in the homogeneous supra-conductor. In the *stationary* case ($\partial/\partial t = 0$), from the last equation of (1), $E$ is zero in the supra-conductor. The $E$-lines therefore issue orthogonally from its surface, which, for the outside, acts as a surface of constant potential like with an ordinary conductor of vanishing resistance.

I consider this form of London's theory a rational heuristic starting point. So far as I can see, it is both self-consistent and without contradiction of other principles. The actual state of affairs is, of course, more complicated. It is well known that it presents phenomena of hysteresis, which cannot be embodied in a simple field theory.

E. SCHRÖDINGER.

24 Northmoor Road,
Oxford.

[1] *Physica*, 2, 341 (1935).
[2] *Proc. Roy. Soc.*, A, 149, 71 (1935).
[3] *Z. Phys.*, 96, 363 (1935).

## Scattering of Neutrons by Protons

IT is known that hydrogen shows a large scattering cross-section for slow neutrons. On the usual assumption that the forces between proton and neutron are of short range, this can only be explained if one also assumes[1] that the deuteron has an excited state, real or virtual, the energy of which $|W_1|$ is about 50,000 e.v. This leads to the following formula for the scattering cross-section $\sigma$ of hydrogen for neutrons of energy $E$:

$$\sigma = \frac{h^2}{\pi M}\left\{\frac{3}{4}\frac{1}{W_0 + \frac{1}{2}E} + \frac{1}{4}\frac{1}{|W_1| + \frac{1}{2}E}\right\}.$$

Here $h$ is Planck's constant, $\frac{1}{2}M$ is the reduced mass of the proton and neutron, and $W_0$ is the binding energy of the deuteron[2,3] (cf. also ref. 4) ($W_0 = 2{\cdot}2 \times 10^6$ e.v.). $|W_1|$ is defined by the value of $\sigma$ for $E \rightarrow 0$ (slow neutrons).

To check this formula, I have measured the mean free path in paraffin of the photo-neutrons from radiothorium and deuterium[2]. These neutrons are fairly homogeneous in velocity and their average energy is probably[2,3] (cf. also ref. 4) about 200,000 e.v. The photo-neutron source consisted of 5 millicuries

radiothorium surrounded by 23 gm. heavy water ($D_2O$) and was 3·4 cm. in diameter. It was placed at a distance of 38 cm. from the face of the 'fast neutron detector'. This was an ionisation chamber filled with boron trifluoride enclosed in a cylindrical paraffin block of 12·5 cm. diameter[5]. Alternate runs were made with and without a 'thin' paraffin scatterer, a disk 6·6 cm. in diameter and 1 cm. thick (0·9 gm./cm.$^2$) placed at a distance of 25 cm. from the face of the neutron detector. (The result justifies us in regarding this scatterer as 'thin'.) More than 3,000 boron disintegrations were recorded in each case, and the effects found were $I_1 = 4·5 \pm 0·1$ and $I_0 = 5·4 \pm 0·1$ disintegrations per minute respectively.

From this we can calculate an upper limit of 5·5 cm. of paraffin for the mean free path $\lambda$ of the neutrons used. This is an *upper limit* since, first, some of the neutrons scattered from the walls of the room may be counted, thus increasing the ratio $I_1/I_0$. It appears that an effect of this kind cannot have been large, because when 'artificial walls', made either of lead or of paraffin, were built up near the counter and source, no appreciable increase in the number of disintegrations was found. Secondly, a certain fraction of the neutrons will be scattered by the paraffin disk into the neutron detector. These scattered neutrons will have somewhat different directions and a smaller energy than the neutrons in the primary beam, and will therefore be counted with a probability which may, on the average, be larger than that of the primary neutrons. A rough estimation of this effect was made and a corrected value for the transmitted intensity of $4·3 \pm 0·2$ was obtained. This gives a mean free path $\lambda = 4·5 \pm 1·5$ cm. of paraffin, whereas the value calculated from the above formula is only 1·3 cm.

Although the accuracy of this measurement is not very high, there can be little doubt that the present theory is in definite disagreement with experiment. It can be seen from the above formula that no alteration within reasonable limits of the values of $W_0$, $|W_1|$ and $E$ can bring about an agreement. It seems therefore safe to conclude that there is at present no evidence for the existence of an excited state of the deuteron, and that another model of the proton–neutron interaction is required.

M. GOLDHABER.

Cavendish Laboratory,
Cambridge.
May 5.

[1] Fermi, *Phys. Rev.*, **48**, 570 (1935); Wigner, unpublished, cf. Peierls, "Reports on Progress in Physics", London, 1935, p. 27.
[2] Chadwick and Goldhaber, *Proc. Roy. Soc.*, A, **151**, 479 (1935).
[3] Feather and Bretscher, NATURE, **136**, 468 (1935).
[4] Ising and Helde, NATURE, **137**, 273 (1936); Oliphant, NATURE, **137**, 396 (1936).
[5] Chadwick and Goldhaber, *Proc. Camb. Phil. Soc.*, **31**, 612 (1935); Amaldi, d'Agostino, Fermi, Pontecorvo, Rasetti and Segrè, *Proc. Roy. Soc.*, A, **149**, 522 (1935).

## A Numerical Method for Two-dimensional Fourier Synthesis

TWO-DIMENSIONAL Fourier synthesis is a most useful tool in the hands of the crystal analyst. A Patterson[1] synthesis, which uses observed intensities directly, is the only way of summarising in one picture all the information contained in a set of intensities, and at the very least it is a useful aid in the guessing of probable structures. Further, once an approximate structure has been obtained, a method of successive Fourier syntheses of the ordinary type introducing more and more $F$'s as the signs become known will enable parameters to be found which are the best possible values obtainable from the data involved.

These uses require that a worker in crystal structure shall be able to construct a Fourier synthesis of reasonable accuracy in a very short space of time, and the method here described seems to be the most speedy of the methods which have been used. It will be described more fully elsewhere.

The problem is the summation over the area of the projection of a number (which may, for example, be eighty) of cosine 'waves' of the type shown in Fig. 1. The eighty different waves correspond to the values of $F$ (or of some function of $F$ in a Patterson synthesis) for all the different reflecting planes. In the case of a two-dimensional synthesis all the reflecting planes belong to one zone which we shall assume here to be the $c$-axis zone, so that the orientation and spacing of the planes are defined by the indexes $h$ and $k$. Summation may be necessary over something like 1,800 points (supposing that one half of the total area has to be evaluated and that the projection

FIG. 1.

edges are divided into 60 parts) in order to retain all the information contained in the intensities. We have therefore to add up eighty terms of the type $F(hk) \cos (2\pi hx/a + 2\pi ky/b)$ for each of the 1,800 points. The mere writing down of so many numbers is exceedingly tedious and the summations are long even with the use of a machine.

The number of figures to be summed over the whole area may, however, be reduced by a factor of the order ten, by a preliminary combination of the waves. For example, all those waves of frequency 5 parallel to the $y$ direction (that is, corresponding to $k = 5$) combine, for each value of $x$, into a simple wave of frequency 5 parallel to $y$. The amplitude and phase of this wave vary as the value of $x$ varies; in order to avoid the difficulty of varying phase, we may alternatively represent it as the combination of a sine and a cosine wave of which the amplitudes alone vary.

The calculations are therefore immensely shortened if we consider the whole group of reflections with $k = 5$, make a preliminary summation which shows how the amplitudes vary with $x$, and thus for each $x$-level represent the whole group by one pair of cosine and sine waves of appropriate amplitude. This is repeated for each value of $k$, and we have only a small number of waves to add for each $x$-level.

In order to carry out the summations, we prepare a set of card strips for both cosine and sine waves.

Each strip represents the contribution of the waves at intervals of 1/60 of a cell edge. The strips are prepared for all amplitudes between $\overline{99}$ and 99, and all frequencies (that is, number of waves in the cell edge) up to 20. When summing a set of Fourier terms we only have to select the appropriate strips, place them one beneath the other, and sum the columns.

By using cosine and sine terms separately in preliminary and final summations, full use of the symmetries possessed by these functions can be made. It is not necessary to have the strips written out for more than one quarter of the cell edge. The cosine waves corresponding to even indexes and the sine waves corresponding to odd indexes are all symmetrical about the point $\frac{1}{4}$, while the others are anti-symmetrical about this point.

The strips are stored in boxes as shown in Fig. 2. One box contains all the cosine strips and another the sine strips, and each compartment contains the strips of one frequency. The sloping sides of the boxes ensure that when a strip is removed its place is left open for its re-insertion.

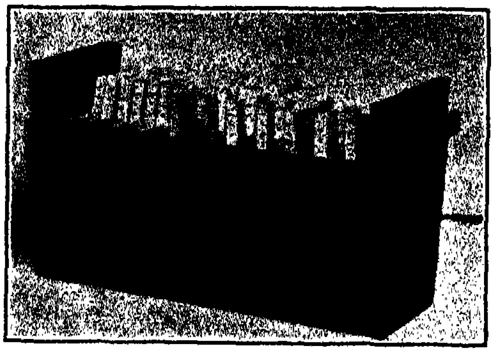

FIG. 2. Set of cosine strips in box.

The use of amplitudes from 1 to $\pm$ 99 is adequate for all work of normal accuracy. If only a few of the totals of the preliminary tables exceed 99, these totals can be made up by the use of two of the strips instead of one in the final tables. If a large number of the totals of the preliminary tables exceed 99, then all these totals should be divided by some suitable factor.

It is estimated that one worker using the strips can complete a Fourier synthesis of the size of the example used here in a total time of eight hours. (A rough estimate of the length of a Fourier synthesis can be made by giving the total number of terms involved if the complete summation were done directly. In our example, 80 $F$'s are summed over 1,800 points, making 124,000 terms in all.) A further utility is that the selection and addition of the strips can be done by inexperienced persons, and the results checked with certainty by doing one line of the synthesis along one $y$-level, thus crossing all the previous $x$-levels.

We should be glad to know if workers in other laboratories who employ the Fourier method would find these sets of strips useful, as it may be possible to arrange for the supply of copies.

C. A. BEEVERS.
H. LIPSON.
Physical Laboratories,
University, Manchester.
March 7.

*Z. Krist.*, A, 90, 517 (1935).

## Magnetic Anisotropy of Resorcinol

THE diamagnetic anisotropy of a large crystal of resorcinol, weighing 0·05550 gm., has been measured by methods similar to those described by Krishnan[1], with the following results:

$$\chi_a - \chi_c = -\ \ 5{\cdot}36 \times 10^{-6} \text{ C.G.S. E.M.U.};$$
$$\chi_b - \chi_c = -13{\cdot}17 \times 10^{-6} \quad ,, \quad ,, \ ;$$
$$\chi_b - \chi_a = -\ \ 7{\cdot}74 \times 10^{-6} \quad ,, \quad ,, \ ;$$

$a$, $b$, $c$ being taken in accordance with Robertson's recent renaming of these axes[2], whereby $a : b : c = 10{\cdot}53 : 9{\cdot}53 : 5{\cdot}66$ A. Resorcinol is very soluble in water and in all the usual organic solvents, and Rabi's method[3] for the measurement of the absolute susceptibility in a given direction could not therefore be used. The mean susceptibility of powdered resorcinol has, however, been measured by Pascal[4] and using his value, $\chi_m = 67{\cdot}2 \times 10^{-6}$, we obtain $\chi_a = -66{\cdot}4$, $\chi_b = -74{\cdot}2$, $\chi_c = -61{\cdot}0 \times 10^{-6}$.

Now in an orthorhombic crystal

$$\left.\begin{aligned} \chi_a &= K_1 \cos^2\alpha_1 + K_2 \cos^2\alpha_2 + K_3 \cos^2\alpha_3 \\ \chi_b &= K_1 \cos^2\beta_1 + K_2 \cos^2\beta_2 + K_3 \cos^2\beta_3 \\ \chi_c &= K_1 \cos^2\gamma_1 + K_2 \cos^2\gamma_2 + K_3 \cos^2\gamma_3 \end{aligned}\right\} \quad . \quad . \quad . \quad (1)$$

where $\cos\alpha_1$, $\cos\beta_1$, $\cos\gamma_1$, are the direction cosines of $K_1$ relative to $a$, $b$, $c$, and so on; $K_1$, $K_2$, $K_3$ being the three principal susceptibilities of the molecule.

If $K_1 = K_2$, as is approximately true for most aromatic compounds, then

$$\left.\begin{aligned} \chi_a &= K_1 + (K_3 - K_1)\cos^2\alpha_3 \\ \chi_b &= K_1 + (K_3 - K_1)\cos^2\beta_3 \\ \chi_c &= K_1 + (K_3 - K_1)\cos^2\gamma_3 \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad (2)$$

Hence if $K_1$ and $K_3$ can be estimated correctly, the direction cosines of the normal to the molecular plane can be calculated. As shown by Krishnan (*loc. cit.*), a good estimate of the molecular susceptibilities may be obtained by adding to each of the principal susceptibilities of benzene the difference between the mean susceptibility of benzene and that of resorcinol.

$$\text{Thus } \left.\begin{aligned} K_1 = K_2 &= -\ 37{\cdot}3 - 11{\cdot}9 = -\ \ 49{\cdot}2 \\ K_3 &= -\ 91{\cdot}2 - 11{\cdot}9 = -103{\cdot}2 \end{aligned}\right\}$$

and on substituting in (2), we obtain

$$\alpha = 55{\cdot}6^\circ,\ \beta = 47{\cdot}1^\circ,\ \gamma = 62{\cdot}1^\circ.$$

The same angles derived by Robertson from a single Fourier analysis[5] are

$$\alpha = 56{\cdot}1^\circ,\ \beta = 46{\cdot}9^\circ,\ \gamma = 61{\cdot}3^\circ,$$

in good agreement with the above.

KATHLEEN LONSDALE.
Davy Faraday Laboratory,
Royal Institution, W.1.

[1] *Phil. Trans. Roy. Soc.*, A, 234, 265 (1935).
[2] *Z. Krist.*, 89, 518 (1935).
[3] *Phys. Rev.*, 29, 174 (1927).
[4] *Ann. Chim.*, 25, 344 (1912).
[5] NATURE, 136, 755 (1935).

## Fine Structure of the $L_{23}$ Absorption Edge of Magnesium Metal

IN the region of ordinary X-rays, variations in the intensity of radiation transmitted through a metal foil on the short wave-length side of an absorption edge have led to interesting results in relation to the zone-structure of the unoccupied electron levels of a metal. The extension of such 'fine structure' measurements to absorption edges which lie in the region of ultra-soft X-rays (say 100–300 A.) allows the possibility of a considerable increase in the resolving power of the method, since in this region the breadth

of the underlying $K, L$ . . . levels is known to be only of the order of 1/4 volt.

We have therefore investigated the intensity of light transmitted through a foil of magnesium on the short wave-length side of the $L_{23}$ absorption edge, the wave-length of which has been determined by Sanner[1] as 250·25 A. A thin film of magnesium $10^{-5}$–$10^{-4}$ cm. thick was evaporated on to very thin celluloid (some 50 A. thick), and as light source a vacuum spark between molybdenum electrodes was used. The radiation was analysed with a 1-metre grazing-incidence vacuum spectrograph and, using 'oiled' plates, spectra were taken with and without the absorbing foil in position behind the slit. With the foil in place, an exposure increase of some thirty times was required. The usual methods of microphotometry were employed to translate the observed densities, so that, at least roughly, the ratio of the intensity of the transmitted light to the incident light could be obtained for various wave-lengths.

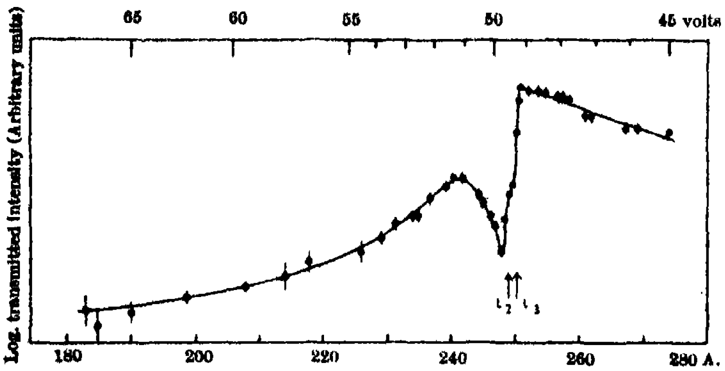


FIG. 1.

The result is shown in Fig. 1. The wave-length 250·7±0·2 A. at which absorption just starts is slightly longer than that given by Sanner. The $L_2$ and $L_3$ edges appear to be just resolved, with a separation of 1·3 A. The most striking feature of the curve is the quite sharp absorption maximum which occurs just on the short wave-length side of the edge. This should be compared with a similar peak in the emission intensity which occurs for magnesium just on the long wave-length side of the $L_{23}$ emission band limit, as shown by O'Bryan and Skinner[2]. In fact, it is easily seen that experiments on the X-ray emission bands and on the absorption edge fine structure give complementary information regarding the electron levels in a metal, and it is satisfactory to find that in the case of magnesium, the data from the two sources fit together. In this way direct information with regard to the overlapping of the first two Brillouin zones is obtained.

We have also observed other absorption edges in the soft X-ray region, namely, the $K$-edge of lithium at 227±1·5 A., the $M_{23}$ edge of cobalt at 202±1 A. and the $M_{23}$ edge of nickel at 190·5±1·5 A. Unfortunately, the plates were not good enough for fine structure measurements, but we hope shortly to be able to make the necessary improvements in the technique.

H. W. B. SKINNER.
J. E. JOHNSTON.
H. H. Wills Physical Laboratory,
University, Bristol.
April 8.

[1] *Z. Phys.*, 94, 523 (1935).
[2] *Phys. Rev.*, 45, 370 (1934).

## Intensity Anomalies in the Lyman Series of Hydrogen

IN 1930 we reported elsewhere[1] that when a condensed discharge is passed through a neon tube in which hydrogen appears as a trace of impurity, the Balmer series is seen remarkably well developed. We have been applying the same method for the extension of the Lyman series and have been able recently to get as far as the 20th member.

During this experiment, we noticed an interesting phenomenon, namely, that at times the third member of the Lyman series ($L_3$) is abnormally weakened, or even disappears. While we were in doubt if the phenomenon is caused by absorption by some impurity, a paper by Price and Collins[2] reporting on the absorption band of $O_2^+$ came out, and we noticed that there is a band ($H_4$) exactly coinciding with $L_3$. This led us to admix a slight amount of oxygen by passing it into the spectrograph through a narrow capillary, so that the partial pressure of oxygen was kept less than 0·1 mm. while the pumping was going on.

Fig. 1 shows the reproduction of one of our spectrograms thus taken, first without ($a$), and then with ($b$) the flow of oxygen. It was taken in the first order of a 1-metre grating at grazing incidence with an exposure of 2 hours.

In Fig. 1 $b$ it will at once be noticed that not only the line $L_3$, but also the line $L_4$ is absent, and the line $L_6$ is abnormally weak compared with its adjacent members $L_7$ and $L_5$.

Upon referring to the data given by Price and Collins[2] (Table I, p. 717), we noticed that here again the coincidences of the frequencies are fairly close, namely, between $L_4$ and $M_4$, and $L_6$ and $M_5$.

Among the other members of the Lyman series, there is still one more instance of such a coincidence in frequency, namely, between $L_{13}$ and $M'_5$. As the line $L_{13}$ appears rather faint on most of our spectrograms, the evidence was not so clearly seen as in the above three cases.

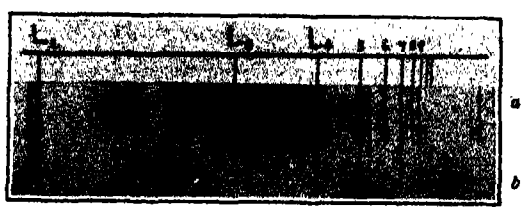


FIG. 1.

The frequencies of the lines here discussed are given in the accompanying table:

| Line and Band | $\nu$ in cm.$^{-1}$ | $\Delta\nu$ in cm.$^{-1}$ | $\Delta\lambda$ in A. |
|---|---|---|---|
| $L_3$<br>$H_4$ | 102823<br>102820 | 3 | 0·03 |
| $L_4$<br>$M_4$ | 107439<br>107460 | 21 | 0·2 |
| $L_6$<br>$M_5$ | 108324<br>108360 | 36 | 0·3 |
| $L_{13}$<br>$M'_5$ | 109118<br>109130 | 12 | 0·1 |

The fact that the inflow of oxygen makes such a strong line as $L_2$ disappear completely shows that the $O_2^+$ bands must have enormous transition probabilities, just as mentioned by Price and Collins.

TOSHIO TAKAMINE.
TARO SUGA.

Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo.
Dec. 26.

[1] T. Takamine and T. Suga, *Sci. Pap. I.P.C.R.*, **14**, 117 (1930).
[2] W. C. Price and G. Collins, *Phys. Rev.*, **48**, 714 (1935).

## X-Ray Examination of Tooth Structure

THE study of the structure of teeth by X-ray diffraction methods[1] has shown that the apatite crystals of the enamel are preferentially oriented whereas those of the dentine are arranged at random. The enamel orientation is such that the crystals tend to have the [001] direction (that is, the hexagonal axis) in common.

It was found in the case of human tooth enamel that the fibre-axis could take up one or both of two positions, referred to as orientation (i) and orientation (ii) respectively. Also variations in the extent of the enamel orientation were shown to exist. In addition, it was shown by radiographic methods that differences in degree of calcification between neighbouring portions of a tooth could be detected.

An attempt is being made to link up the variations in structure revealed by X-rays with the histology and surface texture of teeth, and the present note gives a very brief summary of some results recently obtained.

Sections of human deciduous teeth have been examined by X-ray diffraction methods and by radiographic methods, and the tooth surfaces have been examined by X-ray diffraction methods. 'Good' enamel has been taken to be enamel which is smooth on the surface, is free from pigmentation in section and does not take up stain. 'Bad' enamel, on the other hand, has been taken to be enamel which is rough or uneven in its surface texture, and is pigmented in section. The criteria chosen for 'good' and 'bad' enamel are in fact those put forward by Mrs. Mellanby in her "Diet and the Teeth"[2].

From the results so far obtained, it is tentatively suggested that it is desirable for the following conditions to be satisfied by enamel:

(*a*) Radiographs should give no indication of poor calcification.

(*b*) The enamel should contain a large amount of preferentially oriented apatite, the degree of perfection of orientation being high.

(*c*) Orientation (ii) should occur (see above).

A few of the individual results may be of interest. For example, the work shows that the arrangement of crystallites is, on the average, not the same at the surface of the enamel as in the interior. This is indicated by the fact that whereas orientation (i) is almost always predominant in the enamel sections, orientation (ii) is often predominant in surface enamel.

It has also been shown that, generally speaking, a tooth is entirely enclosed by a thin layer of hyper-calcified tissue. The outer enamel layer may possibly act as a protective layer and play some part in preventing caries.

A further point concerns the nature of translucent zones in the dentine. It has been generally felt that these were zones of hyper-calcification, and the X-ray evidence has confirmed this view. Moreover, similar hyper-calcified zones exist which are not translucent to light but are of normal opacity.

The work is being carried out on behalf of the Dental Disease Committee of the Medical Research Council, to which I am indebted for permission to publish this note. A full account will appear elsewhere.

J. THEWLIS.

Physics Department,
National Physical Laboratory,
Teddington, Middlesex.

[1] J. Thewlis, *Brit. J. Radiol.*, **5**, 353 (1932). *Brit. Dental J.*, **57**, 457 (1934). *Phil. Mag.*, **19**, 291 (1935).
[2] Mrs. Mellanby, "Diet and the Teeth", Part III. Spec. Rep. Ser. Med. Res. Council, London, No. 191, p. 38 *et seq.*, p. 100 *et seq.* (1934).

## Natural Sources of Fluorine and 'Mottled Teeth' in Maldon, Essex

ACCORDING to Leon Williams[1] "mottled enamel is an endemic dystrophy of this tissue. The teeth are characterised by a dead white and milky appearance which is varied by brown and yellowish spots and bands". Fluorine in the drinking water is now known to be the cause of mottled teeth. That such low concentrations as one part per million can be effective is remarkable[2]. Fluorine from chemical works or resulting from volcanic activity can get into soil and pasture and cause fluorosis in cattle[3].

To investigate to what extent, in a mottled teeth area, fluorine is likely to be taken in by man and animals by means other than in water, a few determinations of fluorine were made in materials obtained from Maldon, Essex, and its environs, the only region in England where mottled teeth have been recognised[4].

| | | Fluorine |
|---|---|---|
| Teeth of wild rabbit from near Maldon | contained | 0·0283 per cent. |
| " " " " " Surrey | " | 0·0053 " " |
| Grass from Maldon | " | 0·0003 " " |
| " " London | " | 0·0001 " " |
| Pond water from Maldon | " | 1·2 parts per mill. |
| " " " London | " | 0·5 " " " |
| Well water from Maldon | " | 5·0 " " " |
| Main water in London | " | 0·5 " " " |

That very low concentrations of fluorine in drinking water can be effective might be explained by the fact that simultaneously fluorine is being ingested in plant and animal foodstuffs. Though such sources are less important, they should be considered as possible contributory sources. The reason why acquisition through the water supply has seemed to be the all important is no doubt due to the fact that the fluorine in water occurs as sodium fluoride, whereas in foodstuffs it more likely occurs combined with calcium, in which combination it is known to be less toxic.

J. H. BOWES.
M. M. MURRAY.

Department of Physiology,
Bedford College,
London, N.W.1.

[1] Leon Williams, *J. Dental Res.*, **5**, 117 (1923).
[2] Smith, *Indust. and Eng. Chem.*, Anal. Ed., **7**, 23 (1935).
[3] Christiani and Gautier, *C.R. Soc. Biol.*, **92**, 139 (1925).
[4] Ainsworth, *Brit. Dent. J.*, **55**, 233 (1933).

## Nazi-Socialism and International Science

IN an article which appeared in NATURE of December 14, 1935 (136, 927) under the above title, it is stated that the objects of the Wissenschaftliche Kongress-Zentrale (now the Deutsche Kongress-Zentrale) are to serve as a supervising influence upon German science and to introduce the ideas of the National-Socialist party into the discussions of conferences.

This statement completely misinterprets the object of the Congress Centre. The Congress Centre is a branch of the Berliner Medizinische Gesellschaft, which created it because it is part owner of the Langenbeck-Virchow-Haus in which many national and international congresses are commonly held. It has been found that everyone wishing to organise a congress has been compelled to start from the beginning each time. The experience of a previous organiser of a national or international congress is often lost since invariably a new personnel takes over the organisation of the next congress.

It is the object of the Congress Centre to collect and systematise this experience, which for the most part is of a purely technical nature. Examples of the questions dealt with are applications for bills of exchange, the form and the issuing of invitations, the agenda paper, travel concessions, arrangement of excursions in connexion with the congress, the report of the congress, the form of the reception, the arrangement of the office of the congress, etc. The Congress Centre will place this accumulated experience at the disposal of organisers of fresh congresses. An intending congress organiser is thus relieved of a great part of his work and has the assurance that nothing is forgotten. He is, therefore, the better able to devote himself to the details of the programme and the scientific aspects of the congress. For these the organising committee of the congress, which is entirely independent of the Congress Centre, is alone responsible, and usually they are entrusted to an eminent scientific authority on the subject.

The origin of the belief that the Congress Centre has an influence on the choice of scholars travelling to international congresses lies in the fact that the Congress Centre undertakes applications for bills of exchange for these persons. Owing to the very difficult exchange position in Germany, it is impossible for every German man of science to take part in a foreign congress. The number must be limited to the number of bills of exchange available on the country in question. For example, of the 90 Germans who applied, only 25 were able to attend the International Physiological Congress, because the Reichsbank issued bills of exchange for only 25 persons. As applications for bills of exchange are made by the Congress Centre, the erroneous impression can arise that the choice of participants is made by this body.

The Congress Centre is thus an arrangement, arising from purely practical requirements, for the assistance of congress organisers. We may perhaps mention that the Berliner Medizinische Gesellschaft has existed for seventy-five years, and is the largest medical association in Germany.

C. F. O. C. ADAM.
(Managing Secretary.)
Berliner Medizinische Gesellschaft,
(Langenbeck-Virchow-Haus),
Berlin.
April 14.

## Scientific Workers and War

DURING recent months, several items have appeared in NATURE which were concerned at least in part with the topics of warfare, past or future. This may be taken as an expression of the realisation that science has given modern warfare its catastrophic character. While scientific investigators cannot be held directly responsible, many of them are coming to feel that they cannot remain indifferent to the indirect effects of their work.

The practical working of modern civilisation depends so largely on technical knowledge that if everyone with scientific training were to act for one common aim, that aim could be achieved. Probably the majority of scientific workers the world over prefer peace to war, and there can be no doubt that English scientific workers as a body are united in this matter. This being so, can they take action as such, apart from anything they may think worth doing in conjunction with non-scientific bodies? It seems to us that such action is not only possible but also urgently needed.

Certain objects must be, and indeed are, sought for by all scientific workers who wish for peace, such as the maintenance of the international character of science and the safeguarding of the public from scare-mongering or scientifically inaccurate statements. Apart, however, from such grounds as those, individuals are divided as to how peace is to be attained, and each point of view has its appropriate line of action.

There are first of all those who think that while war between nations is undesirable, it is still the final support of justice, and hence, in the long run, it may be the road to peace: such scientific workers will not be opposed to strong armaments, or to war research as such, but they will insist that at the same time the fullest support will be given to the principle of collective security.

Secondly, there are those who regard all war as a barbarous and destructive activity, a means which no end will justify, and who consider that aggression could be stopped by effective and whole-hearted action of a non-military character by the nations of the world. They will refuse to do research which is obviously directed towards war, and they will try to prevent such research being carried on in the universities. They will demand that if money must be spent on war research, it should be for defensive purposes only, and that the work should be published. If objection is raised to publication, then the research is probably not purely defensive in character. Again, they would organise themselves quite specifically to resist the efforts of a war-making Government in any country to coerce them into helping the war-machine when it is set going. From their point of view, it is all-important that such organisation should be in existence before any coercion is actively begun.

A third section comprises the complete pacifists, who differ as far as their practical activities are concerned in their objection to sanctions of any kind, but as scientific workers they would join in any organisation to resist the use of their services for war if war comes.

Lastly, there are many who think that in the long run war is inevitable under capitalism, and are working for the establishment of world socialism. Their immediate policy is to use any means which can stave off the outbreak of war, and they would

therefore be willing to join with those of other opinions in various practical ways.

There may be considerable overlapping between these sections of opinion, but in spite of theoretical differences, there will be occasions on which all can unite for the time being. War would be impossible if all scientific workers opposed it. Each individual scientific worker should first consider what ought to be done, and then use his influence to see that it is done.

C. H. BAMFORD, B.A.
J. D. BERNAL, D.Sc.
E. J. BUCKLER, B.A.
V. M. CONWAY, B.A.
M. C. A. CROSS, B.A.
R. C. EVANS, Ph.D.
D. W. EWER, B.A.
J. H. FREMLIN, B.A.
S. GLASSTONE, B.A.
H. GODWIN, Ph.D.
B. E. HOLMES, Ph.D.
A. F. W. HUGHES, Ph.D.
E. LEIGHTON YATES, B.A.
E. R. LOVE, B.A.
E. C. MACIRONE, M.B., B.S.
D. M. NEEDHAM, Ph.D.
J. NEEDHAM, Sc.D.
D. P. R. PETRIE, B.A.
A. PIRIE, Ph.D.
D. RICHTER, B.A.
E. B. VERNEY, M.B., F.R.C.P.
A. WALTON, Ph.D.

University,
Cambridge.

[The above letter was written independently of the leading article on the same subject which appeared in NATURE of May 9.—Editor.]

## Fertile Sugar Cane × Millet Hybrid

A CONSIDERABLE number of *Saccharum* × *Sorghum* hybrids have been produced at this Station during the breeding seasons of 1933–35. The accompanying photograph (Fig. 1) shows seed germinating in the

FIG. 1.

influorescence of a hybrid between the sugar cane variety P.O.J. 2725 ♀ and Guinea corn ♂ (*Sorghum vulgare*). The plant and panicle were both standing upright when the condition was observed, and the plantlets had wilted, presumably from lack of moisture and nourishment.

P.O.J. 2725 is descended from a cross between *Saccharum officinarum* and *Saccharum spontaneum*, and the latter accounts for one-eighth of its make-up.

Hybrids are frequently characterised by a high degree of sterility, and sugar cane seed germinates so rarely in Nature that for many years it was thought that the plant could only be reproduced asexually. It therefore seems of general interest to record this marked fertility in an intergeneric (*Saccharum* × *Sorghum*) hybrid.

C. HOLMAN B. WILLIAMS.
C. CAMERON.

Sugar Experiment Station,
Department of Agriculture,
British Guiana.
March 13.

## Two Methods of Formation of Dictyosomes from Vesicular Golgi Bodies

OOGENESIS studies have revealed that the Golgi bodies may have a variety of shapes ranging from a granule and a vesicle to a typical dictyosome[1,2]. We have always been faced with the question whether these shapes are fixed or whether one could be derived from the other. Scattered in the literature on spermatogenesis[3] and secretory phenomena[4,5] we also find batonettes described with double chromophilic rims. If these double-rimmed batonettes have a real existence, what is their relation to the other shapes of the apparatus? From the evidence at our disposal we feel that these types of batonettes could be derived from the vesicular Golgi bodies, the vesicles themselves being derived from granules.

Fig. 1 is a reproduction of a photomicrograph of a growing oocyte of *Clibanarius olivaceus*. At *gg* are shown the Golgi grains in which there is no differentiation into chromophilic and chromophobic regions. These enlarge and give rise to vesicles ($gg_1$) in which the two regions become visible. Rupture of these vesicles ($gg_2$) takes place at varying stages of the growth of the vesicles and gives rise to batonettes of

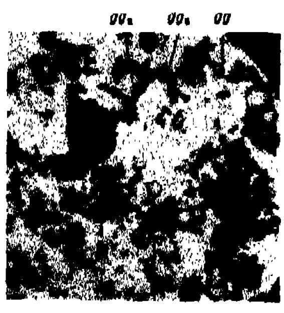


FIG. 1. Oocyte of *Clibanarius*. ×900.

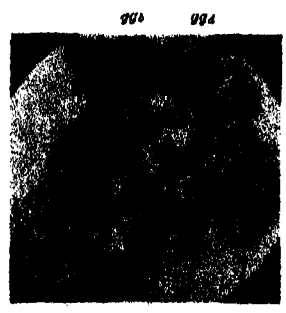


FIG. 2. *Lycastis* material. ×900.

varying sizes. A typical batonette formed by such a rupture is shown at $gg_3$. A glance at the photomicrograph will show how the chromophobic area which is enclosed by the chromophilic region in the vesicles comes into relation with the cytoplasm.

In *Lycastis indica* we observed double-rimmed batonettes, which differed from those described in *Clibanarius olivaceus* in having the chromophobic part between the two chromophilic rims. In some of the batonettes the chromophobic part completely disappears. In Fig. 2 are shown the various stages in the transformation of a vesicle into a double-rimmed batonette. Instead of the vesicle rupturing, the final result seems to be attained in a peculiar way. An infolding ($gg_a$) similar to gastrula formation takes place, and by an extension of the process ($gg_b$)

a double-rimmed batonette results. By still closer apposition of the two chromophilic regions the chromophobic part completely disappears. Naturally, there are also instances of multiple folding of the walls of the vesicle. The disappearance of the chromophobic part in relation with the Golgi batonette in *Lycastis indica* will be apparent if one compares Figs. 1 and 2.

The absence of the chromophobic part in the network-like Golgi apparatus of many types of mammalian somatic cells has rendered the acceptance of the theory deriving the network from the typical dictyosomes as postulated by Hirschler difficult[6]. We suggest as a provisional hypothesis that the difficulty may be removed if we conceive that the network is derived from the Golgi batonettes of the type seen in *Lycastis indica*, where the chromophobic part disappears ultimately.

M. K. SUBRAMANIAM.
R. GOPALA AIYAR.

University Zoological
Research Laboratory,
Madras.

[1] L. A. Harvey, *Proc. Roy. Soc.*, B, **107**, 417 (1931).
[2] V. Nath, *Quart. J. Micr. Sci.*, **73**, 477 (1930).
[3] R. H. Bowen, *Biol. Bull.*, **39**, 316 (1920).
[4,5] R. H. Bowen, *Quart. J. Micr. Sci.*, **70**, 75, 193, 395, 419 (1926).
[6] Hirschler, *J. Arch. Mikr. Anat.*, **91**, 140 (1918).

## Origin of the Term 'Solute'

REGARDING the origin of the word 'solute'[1], the following may be added to the references concerning the coining of the word by Prof. Donnan and by the late Prof. N. Story-Maskelyne. In a paper presented to the American Academy on May 9, 1894 (cf. *Proc. Amer. Acad.*, **30**, 325; 1895; but perhaps published in a separate part of this volume during 1894), W. D Bancroft wrote: "There seems to me a need for a word denoting the dissolved substance. In future I shall use the word 'solute', meaning the substance dissolved in the solvent". It appears, therefore, that the use of this handy word was proposed independently and almost simultaneously by several chemists so early as 1894. Prof. Bancroft seems to have been the first to introduce the word in a scientific communication, but Prof. Donnan's suggestion was possibly the earliest to appear in print.

O. J. WALKER.

Sir William Ramsay Laboratories of
Physical and Inorganic Chemistry,
University College, London, W.C.1.

[1] NATURE, **137**, 698 (April 25); 782 (May 2, 1936).

## Points from Foregoing Letters

SIR J. J. THOMSON refers to several objections to his views on the nature of light, and shows how they can be overcome by suitable assumptions concerning the structure of the interior of the atom and the mechanism of light emission, about which he points out there is very little known.

The latest version of the theory of supraconductivity of metals at low temperatures suggested by F. and H. London is simplified by Prof. E. Schrödinger, by assuming Maxwell's equations and the existence of a third type of current, the supracurrent, which is added to, or replaces, the ordinary conduction current.

The mean free path of the neutrons obtained from heavy hydrogen subjected to radiothorium radiation is found by Dr. M. Goldhaber to be $4\cdot5 \pm 1\cdot5$ cm. paraffin. This value cannot apparently be reconciled with that derived from a formula based upon the accepted views, and Dr. Goldhaber concludes that there is no evidence for an excited state of the heavy hydrogen alone, and that another model of the proton–neutron interaction is required.

C. A. Beevers and H. Lipson give a description of a very rapid numerical method for the summation of two-dimensional Fourier series. Sets of printed strips are used, and the method consists merely in the selection and addition of groups of these. Some advantages of this method are pointed out.

Dr. K. Lonsdale has measured the diamagnetic anisotropy of a single crystal of resorcinol. The orientation of the molecular plane relative to the crystal axes has been derived and is found to agree well with the results of a previous X-ray analysis.

The transparence of a very thin film of magnesium metal (100–1000 A. thick) for ultra-soft X-rays (extreme ultra-violet light of 100–300 A. from a molybdenum spark) has been determined by Dr. H. W. B. Skinner and J. E. Johnston. They find a sharp absorption maximum just on the short wavelength side of the absorption edge at 250 A. The fine structure of this absorption edge confirms the information obtained from X-ray emission bands regarding the electron levels in the atoms of the metal. Similar experiments with lithium, cobalt and nickel are in progress.

While investigating the Lyman series of lines in the far ultra-violet, emitted by traces of hydrogen, when a condensed discharge is passed in presence of neon, T. Takamine and T. Suga have observed that certain of the lines were considerably weakened. This, they now find, is due to the presence of a small amount of oxygen, the molecular ions $O_2^+$ having strong absorption bands in the neighbourhood of the hydrogen lines $L_3$, $L_6$, $L_8$, $L_{13}$.

X-ray examinations of tooth structure show, according to J. Thewlis, that good enamel—which is smooth and free from pigmentation—contains a large proportion of preferentially oriented apatite (a crystalline calcium phosphate and fluoride), and shows a sufficient degree of calcification. A special orientation of the fibre axis was also observed.

In a 'mottled teeth' area such as Maldon in Essex, where fluorine in the drinking water is the cause of the mottling, it has been found by J. H. Bowes and Miss M. M. Murray that pond water, grass and rabbits' teeth contained considerably more fluorine than similar substances from other parts. This fluorine may be a contributory cause of the abnormal condition of the teeth.

A photograph of a fertile inter-generic hybrid between a sugar cane variety and millet (Guinea corn) is submitted by C. H. B. Williams and C. Cameron.

A photomicrograph of growing ovarian cells showing the evolution of dictyosomes (particles derived from the nucleus of the spermatozoon after fertilisation of the ovum) are submitted by M. K. Subramaniam and R. Gopala Aiyar. It appears that these are formed from Golgi grains which enlarge into vesicles and rupture, giving rise to batonettes; these, the authors suggest, give rise to the network-like Golgi apparatus.

# Research Items

### Rumanian Folk-Dances

THE current issue of the *Journal of the English Folk Dance and Song Society* (Vol. 2) is devoted to the International (European) Folk Dance Festival, which was held in London on July 14–20, 1935 (see NATURE, July 27, 1935, p. 154). In addition to a detailed report by Mr. F. Howes of meetings, dances and excursions, it contains the papers read at the Conference which formed part of the proceedings. These papers include a study by Dr. Romus Vuia of the remarkable Rumanian dance of the Căluşari, or Hobby-Horse Dance, of which the primitive evolutions attracted so much attention. At the close of a detailed description, Dr. Vuia suggests that the Căluşari, who observe special customs at special places such as water, woods, hills and cross roads, have a magical origin, and that they embody two magical elements (*a*) connexion with the sun, and (*b*) connexion with the fairies, who have a special association with water. That they personify the fairies is indicated by, among other things, their knowledge of healing plants and their nature. Related forms of the dance are found throughout the Balkans, and through these a connexion is suggested with the ancient types of stick and sword dances of western Europe. The hobby-horse which appears in the dance has a double function as both the origin of and the destroyer of fertility. As the demon of fertility it takes away as well as gives. This double aspect of magic also appears in the relation of the Căluşari with the fairies, who both cause and avert disease. The fool of the Căluşari also appears in the Stag Dance at Christmas and the New Year. In this dance he appears with a phallus, and, instead of being killed, as is usual, he himself kills the stag. In its original form the Căluşari was a dance intended to drive away the demons of ill-health.

### The Oriental Migratory Locust

THE February issue of the *Bulletin of Entomological Research* (27, Part I, 1–194) is devoted to a series of papers describing the results of researches on locusts. It is only possible here to comment upon one of the contributions, namely, that of Dr. B. P. Uvarov, on the oriental migratory locust. The swarms of this locust, which occur over north-eastern Asia, the Malay Archipelago and the Philippine Islands are usually referred to the subspecies *migratoriodes* (R. and F.) which inhabits tropical Africa. Dr. Uvarov points out, however, that the oriental locust can be readily separated from the African subspecies since it is a smaller insect with a less constricted pronotum and a narrower head, in its gregarious phase. Its correct designation is *Locusta migratoria manilense*, Meyen, and its claim to be a separate subspecies is based upon material from specimens obtained from a number of widely separated regions. Dr. Uvarov concludes that in the Philippines, Borneo and Malaya, conditions favouring swarm development are brought about by the primitive methods of land utilisation. The grasslands, known in the Philippines as *cogonales*, are the product of shifting cultivation and of repeated burning of the grass. These lands are of a dry, impoverished type and create a habitat alien to the nature of the country but eminently suitable for the locusts. The problem of locust control under such conditions is one which demands careful field studies for its solution.

### British Sawflies of the Genus *Hoplocampa*

DR. H. W. MILES has recently published a revision of the British species of the sawfly genus *Hoplocampa* (*Entom. Mon. Mag.*, March 1936). Altogether, nine species are known at present in Great Britain, and the species *H. brevis* was found for the first time only last year. *Hoplocampa flava* and *H. testudinea* infest plum and apple respectively and are known from most of the important fruit-growing areas of England. While the life-histories of these two species have been tolerably well studied, little is known of the biology of the remaining seven species. *H. alpina* appears to attack, as a larva, the blossoms of mountain ash (*Pyrus aucuparia*), while *H. brevis* lives on the fruits of the pear. The last-mentioned species has only so far been found in Cambridge, but probably has a wider range in southern Britain. The genus *Hoplocampa* is associated with *Pyrus*, *Prunus* and *Cratægus*, and its members probably have only one generation per annum. Dr. Miles gives a key to the determination of the British species, which has been adapted from the works of Enslin and Morice, after a study of recently obtained specimens.

### Ecology of a Sandy Shore

THE Skalling peninsula is a sand-dune area on the west coast of Denmark which partially cuts off a large tidal lagoon from the North Sea. The tidal range there is about 1·6 metres, and at low tide a foreshore of about five hundred metres of muddy sand is exposed on the western side of the lagoon. Thamdrup (*Medd. Komm. Denmarks Fisk. og Havundersøg.*, Ser. Fisk., **10**, No. 2, 1–125) gives a detailed account of the ecology of two traverses from high- to low-water on this shore. He describes first the chemical and physical conditions, including the salinity, hydrogen ion concentration, oxygen content, etc., of the water, and the tidal conditions, and the range of particle size in the sand. He then lists twenty-five species found, and discusses fourteen of them in detail. Notes are given on the general habits of each, and on their breeding periods so far as these are known, and his notes on growth rates, especially of *Arenicola marina*, are particularly valuable. Two molluscs, *Cardium edule* and *Macoma baltica*, are discussed in special detail on the evidence of growth obtained from annual rings on their shells, and Thamdrup shows the differences in mortality of the different year groups in successive years, as well as the wide variation in growth rate, especially in *Cardium*, at different tidal levels.

### A Fungus Parasite of Cabbage

MR. J. R. THOMSON has studied a fungus which causes white spots to appear upon cabbage leaves ("*Cylindrosporium concentricum* Grev."; *Trans. Brit. Mycol. Soc.*, **20**, Pt. 2, 123–132, January 1936). The fungus was first described under the above name by

Greville in 1823, but its nomenclature has undergone many vicissitudes, and finally its first designation was restored by von Hoehnel in 1924. The paper under review substantiates and approves this latter view, and also describes the features of the organism as it occurs upon the host, and as it behaves in pure culture.

### Eureka (California) Earthquake of June 6, 1932

THOUGH not of great destructive power, this earthquake forms the subject of an interesting study by Mr. N. R. Sparks (*Bull. Seis. Soc. Amer.*, 26, 13–27; 1936). It affected chiefly the region around Humboldt Bay in Northern California, the shock being felt from Coos Bay on the north to San Jose on the south, a distance of more than four hundred miles. Nearly all the brick chimneys round Humboldt Bay were damaged or thrown down, the tops of many of those left standing being rotated in a clockwise direction. Yet a steel-reinforced concrete stack, 305 feet high, at Samoa, in the central region, was neither cracked nor shifted. The epicentre, as determined by seismographic evidence, lay in lat. 40° 45′ N., long. 124° 30′ W., and this point agrees closely with that given by the isoseismal lines. It lies a short distance off the coast, on the continuation of a fault ruptured at the time of the earthquake of 1906 and apparently parallel to the great San Andreas rift. The depth of the focus was about thirty-seven miles.

### Climate of Czechoslovakia

THERE is a paper by B. Hrudicka among the Publications of the Faculty of Science of the University of Masaryk for 1935 which contains useful climatological information. It is entitled "A Climatic Map of Czechoslovakia according to Köppen's Classification". Köppen's system of classification, it may be recalled, is one of the most successful that has yet been devised. The different climates are distinguished by a number of letters, capitals corresponding with the main features defined by temperature and rainfall, while smaller letters provide for sub-divisions of these. In Czechoslovakia only three main climates are found. All three are humid (*f* according to Köppen), as there is no dry season. They are (1) the humid warm temperate (*Cf*), (2) the humid type with distinctly cold winter, the mean temperature of the coldest month being below −3° C. (*Df*), and (3) in the mountains, the tundra (*ETG*), with the warmest month averaging between 0° C. and 10° C. The climate *Df* appears in the two sub-types *Dfb* and *Dfc*; the former prevails in the low-lying regions, and is characterised by four months or more averaging over 10° C., and the latter with less than four such months, in the moderately high parts. It is interesting to note that marine influences are obviously present in this country; for example, the warmer summer required by *Dfc* compared with *ET* climates results in a rise in the boundary between these two types with distance eastwards; in the same direction there is a fall in the boundary between *C* and *D* due to the increasing severity of the winter with the more Continental conditions in the direction of Russia.

### Absence of Living Bacteria in Stony Meteorites

THAT living bacteria could not exist in aerolites or stony meteorites would probably be generally accepted as a fact. Prof. Charles Lipman, however, four years ago reported the finding of living bacteria in aerolites. He claimed that stony meteorites had brought down with them from somewhere in space "a few surviving bacteria, which can in many cases be made to grow on bacteriological media in the laboratory". It might be thought that the heating of the meteorite in its descent through our atmosphere would destroy any bacteria if they were present. In reply to this objection, it is suggested that owing to poor conductivity, the interior of a meteorite remains cool even though it burns externally. The matter has been reinvestigated by S. H. Roy, using the same aerolites and methods as Prof. Lipman (*Geol. Ser. Field Mus. Nat. Hist.*, Chicago, 6, No. 14, 179, Dec. 12, 1935). The meteorites had first to be powdered aseptically, and then cultured in various special media. Of twelve tubes of culture media inoculated with meteoritic powder, growth appeared in three only, the other tubes remaining without growth over a long period of incubation. The growths obtained were those of two common terrestrial species of bacteria, *Bacillus subtilis* and *Staphylococcus albus*. It is significant that the same organisms were obtained in control plates exposed in the container in which the crushing was carried out. The conclusion reached is therefore that no living bacteria are present in aerolites, such growths as may be obtained being due to unavoidable contamination from the air during the process of preparation for cultivation.

### High Permeability in Magnetic Fields

IT has been known for several years that the magnetic properties of iron and silicon steel are altered by cooling from high temperatures in a magnetic field. This property is only shown by metals and alloys which remain plastic whilst cooling through the Curie point. In the *Bell Laboratories Record* of April, J. F. Dillinger points out that the lowest temperature at which the heat treatment is effective is identical with that at which plastic flow begins to occur. He considers that a magnetic material is composed of small regions in each of which the material is magnetised to saturation in a definite direction. In iron and permalloy it is one of the cubic axes of the crystals, but in an unmagnetised polycrystalline specimen the crystals are oriented at random. As the field is applied, the magnetisation of the various regions tends to become parallel to it. If the temperature is sufficiently high, plastic flow occurs owing to the stresses produced by the magnetisation. When the specimen is cooled, the regions still retain their new directions, and it is relatively easy to remagnetise the specimen in the direction in which the magnetic field was applied. Its permeability will consequently be greatly increased. To find the temperature range in which the application of the field is important, several specimens of permalloy cut from the same casting were heated to 1,000° C. and then cooled to room temperature. It was found that the application of the field as the specimen cools from 600° to 400° C. increases the maximum permeability from about 5,000 to 250,000. It multiplies the permeability therefore by a factor of 50. By very carefully annealing permalloy containing 65 per cent of nickel at temperatures just below its melting point in an atmosphere of hydrogen, and then heat treating it in a magnetic field, the extraordinarily high permeability of 600,000 has been attained.

# High Voltage Laboratory at Queen Mary College, London

ON May 6, the High Voltage Laboratory at Queen Mary College was opened by the Earl of Athlone, Chancellor of the University of London. In this university laboratory, voltages of the order of 1,000,000 are available for the instruction of engineering students. The completion of the Laboratory has been made possible by a grant of £10,000 from the Court of the University.

The use of high voltages for the transmission of electrical energy has been a notable development in electrical engineering practice in recent years. Working voltages in use to-day include 132 kv., 250 kv. and 330 kv. Still higher voltages are projected. Apparatus which has to work at these voltages must be tested by the application of even higher voltages, and the larger companies engaged in the manufacture of electrical apparatus have high-voltage testing laboratories capable of generating 1,000 kv. and, in a few instances, 2,000 kv. In consequence of this development, it is desirable that engineering graduates should possess a knowledge of the principles of high-voltage technology, and it is also desirable that research work on high-voltage problems should be undertaken by post-graduate students. Apart from this commercial aspect, the subject of high-voltage technology is eminently suitable for inclusion in a university engineering course, since it provides scope for the application of physics and mathematics to engineering problems. In particular, transient phenomena have received great attention from engineers since high-voltage engineering became of commercial importance, and a study of the theory of transients will be an important part of any course of instruction in high-voltage technology. While the need for a university course in the principles of high-voltage engineering has long been recognised, it has been difficult for adequate instruction to be given in the subject, because of the high cost of the necessary laboratory equipment and of the buildings.

The authorities at Queen Mary College were fortunate in possessing an existing building which could be readily adapted to accommodate high-voltage equipment, and this building is now the main High Voltage Laboratory. In the rebuilding of the Electrical Engineering Department which has just been completed, two smaller high-voltage laboratories were constructed and these are known as the 150 kv. alternating current and the high-voltage direct current laboratories. Also, the flat roof of the new building provides an excellent outdoor testing area to which various high-voltage supplies can be brought.

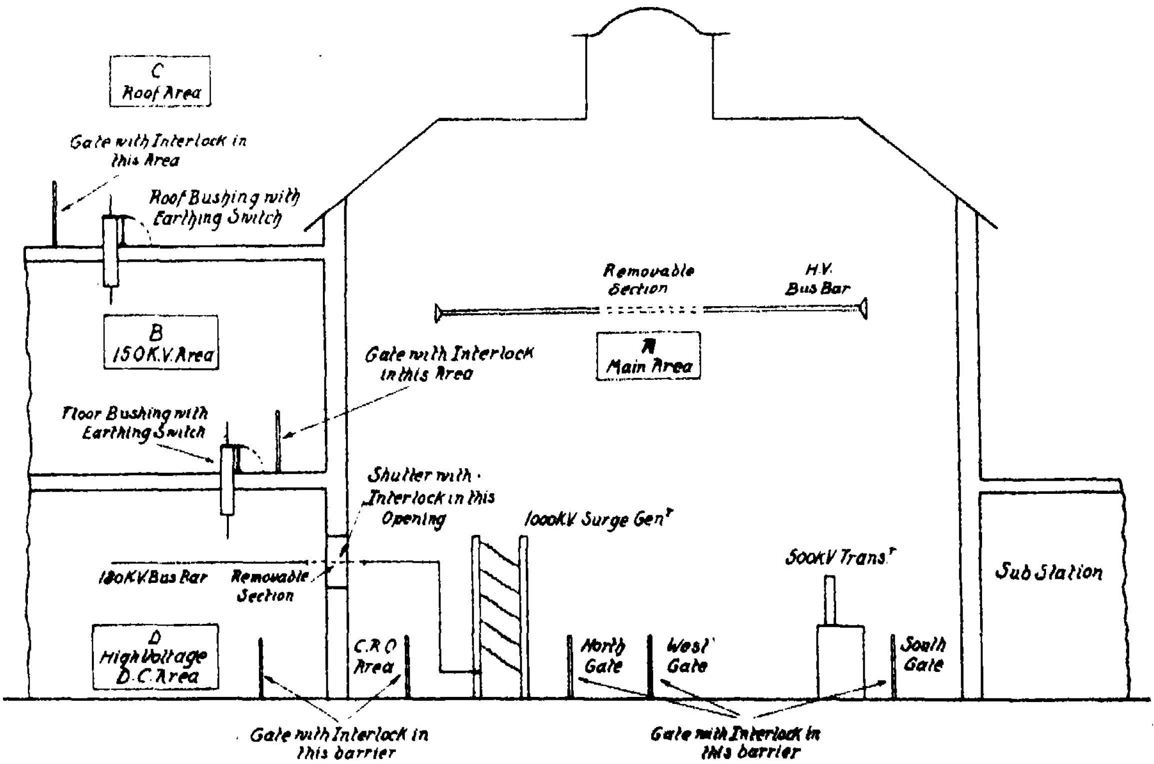


FIG. 1. Arrangement of High Voltage Laboratory, Queen Mary College, London.

The layout of the complete laboratory is shown in Fig. 1. The main items of equipment are as follows:

*Main Laboratory, Area A.*

(*a*) A 1,000 kv. surge-generator for the production of transient voltages.

(*b*) A high-voltage cathode ray oscillograph which enables a record to be taken of transient voltages having a magnitude of 1,000 kv. and a duration of a few microseconds.

(*c*) A 100 kv. Schering bridge for the measurement of losses in dielectrics while these are subjected to high voltages. The equipment includes a 'no loss' condenser using compressed air as dielectric.

(*d*) Two transformers connected in cascade to give 500 kv. at a frequency of 50 cycles per second. The primary supply to these transformers is given by a motor-alternator set of which the motor has a rating of 60 B.H.P. and the alternator a rating of 250 kva. Great care has been taken in the design of the alternator to ensure that its output voltage wave shall be practically free from harmonics under all conditions of operation.

(*e*) A 750 mm. sphere-gap with the spheres arranged vertically above one another, the lower sphere being moved by a motor-operated mechanism controlled from the main control desk. The sphere gap is used for measuring high voltages, both 50 cycle and impulse. It is arranged for use as a crest-voltmeter when required, the spheres then forming the high-voltage condenser of the crest-voltmeter.

150 *kv. Alternating Current Laboratory, Area B.* This area contains a 150 kv. single phase transformer and will be used to give preliminary instruction to students in high-voltage work. It will also be used for research work.

*Roof, Area C.* This area is on the roof of the new building, and supplies can be brought to it from areas *B* and *D*. The area will be used for making tests on outdoor-type insulators under various atmospheric conditions.

*Direct Current Laboratory, Area D.* Here is a 180 kv. direct current generator consisting of condensers and thermionic rectifying valves arranged as a 2-stage voltage multiplying circuit. This generator is used as the supply source for the surge-generator, but it will also be used for other purposes.

The laboratory layout has been carefully arranged so that the more expensive items of the equipment can be used in as many different areas as possible. High voltages are, of course, extremely dangerous and the greatest care has been taken to eliminate risk so far as possible. All the high-voltage testing areas are surrounded by expanded metal barriers. Entrance to the areas is obtained through doors in the barriers, and these are fitted with gate-switches which automatically switch off any high voltage in the area as soon as the door is opened.

The Laboratory is one of the best equipped of its kind in the world. It is hoped that it will serve to supply the electrical industry with engineers having an adequate knowledge of the fundamental principles of high-voltage engineering, and competent to handle the distinctive apparatus used in that branch of engineering. It is also hoped that existing knowledge of high-voltage phenomena will be extended as a result of research work done in the Laboratory.

W. J. JOHN.

# Zoogeographical Divisions of the Palæarctic Region

ALTHOUGH the Palæarctic zoogeographical region, comprising the whole continent of Europe, a great part of Asia and northern Africa, is undoubtedly the best explored as regards its fauna, there has been no satisfactory modern scheme of its sub-divisions. This gap has now been filled* by the veteran Russian entomologist, A. P. Semenov-Tian-Shanskij, son of the famous explorer of Tian-Shan.

The work represents the results of fifty years' study of the distribution of recent Palæarctic Coleoptera, while the geological history of the countries involved and their fossil fauna are also taken into account. Brief characteristics are given of the four sub-regions recognised by the author, and of the provinces into which each sub-region is divided. These sub-regions are as follows:

(1) *Europæo-Siberian sub-region*, characterised by a fauna relatively poor in the number of genera represented, with a low percentage of endemic genera. This fauna is a greatly impoverished Tertiary one. Five provinces are recognised, namely, Arctic, Taiga, Forest, Steppe and the Caucasus province.

(2) *Mediterranean sub-region*, with seven provinces (Canarian, western Mediterranean, Saharan, eastern Mediterranean, Sumerian, Syrian, Hyrcanian). This is populated by a fauna regarded as an immediate development of the Pliocene fauna which has escaped here the influence of the Glacial periods. In some of the provinces, such as the Canarian and the Hyrcanian, some Miocene and even Oligocene relics still exist.

(3) *Central-Asian sub-region.* This is an innovation which is supported by strong evidence. Its fauna has some relation to that of the Mediterranean sub-region, differing from it in two respects. On one hand, many Mediterranean genera and even families have died out here, as a result of desiccation of the country. On the other hand, the desiccation resulted in a great development of numerous progressive endemics characterised by remarkable adaptations to desert life, both in structure and in habits. These evolutionary processes are still very active in several centres of the sub-region, which includes five provinces, namely, the Iranian, Turanian, Dzhungarian, Kirghizian and Mongolian.

(4) *Palæarchearctic sub-region.* This is another new conception. It occupies the south-east of Asia, extending to the Himalayas. Its fauna contains a high percentage of forms which are now mainly tropical, including eight families not represented elsewhere in the Palæarctic region. There are also many Tertiary relics which have survived on the spot since the Miocene and Oligocene. The following eight provinces are recognised: Manchurian, Corean, Japanese, inner Chinese, southern Chinese, Yunnanese, Tibetan and Himalayan.

While certain of the sub-divisions may appear too novel to some zoogeographers, the scheme proposed by the author is obviously superior to all previous ones, and deserves the close attention of anyone working on distributional problems. It is most regrettable that such an important contribution to biogeography should have appeared only in Russian, without even a summary in some other language. Explanations to the map included are, however, given in Latin as well, which will make it more widely available.

* "Les limites et les subdivisions zoogéographiques de la Région paléarctique pour les animaux terrestres basées sur la distribution géographique des insectes Coleoptères". By André Semenov-Tian-Shanskij. (Leningrad: Zoological Museum, Academy of Sciences, 1936.)

# Fuel Industries Research at Leeds*

IN his Report for the session 1934–35 to the chairman and members of the Livesey Advisory Committee on the work of the Department of Coal Gas and Fuel Industries (with Metallurgy) of the University of Leeds, Prof. John W. Cobb is able to record progress in the increased number of first year students, in the recognition by industry of the value of graduation in this Department, and in the acceptance by the Institution of Civil Engineers of the degree in lieu of one or more sections of the associate membership examination. The Department carries on continuous research on problems connected with fuels and refractory materials, and for some years has been conducting an extended investigation of the influence of furnace atmosphere on the scaling of steel. This work has been encouraged and advanced by grants from the Iron and Steel Federation and, through the Iron and Steel Institute, from the Carnegie Research Fund. The recent work in this research has been directed towards the metallurgical aspects of the influence of sulphur compounds on the scaling of steel, more particularly in relation to the treatment of special steels.

Arising out of a study of carbonisation reactions in which the careful fractional distillation of cellulose, at temperatures up to 1,200°, were effected by special procedure, new light has been thrown on the course of the thermal decomposition of organic compounds. Then again, from an examination of the influence of certain surfaces on the cracking of the volatile products of coal carbonisation, the results obtained have suggested a method of modifying the character of tars which is expected to prove to be of practical value. The co-relation of the properties of cokes with their behaviour on combustion in the open grate, and the changes produced in lump coke when partially gasified, were also made the subjects of investigation and study.

An examination by Dr. A. L. Roberts of the torsional strength of refractory materials at different temperatures has been continued. On this subject a paper dealing particularly with the influence of vitreous and crystalline silica was read before the Ceramic Society in November last. In addition, he has made a study of the action of steam and other gases on refractory materials at comparatively low temperatures, and of the variation in their properties in planes at right angles.

A further activity of the Department is in co-operation with the Institution of Gas Engineers in carrying out research under the Joint Research Committee. Recent work has included the investigation of the corrosion of metals in gas appliances, and analyses of tests made on water gas plants to ascertain the influence of moderating the operating conditions, a subject on which very little direction is available as yet.

* The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (John W. Cobb) for the Session 1934–35. Pp. 11. (Leeds: The University, 1936.)

# The Nutritive Value of Milk

A MEMORANDUM on the nutritive value of milk has been prepared by the Advisory Committee on Nutrition which was appointed last year by the Minister of Health and the Secretary of State for Scotland*. It points out that milk is the only food which contains nearly all the materials essential for growth and maintenance of life, in a form ready for utilisation by the body. Mothers' milk is the ideal food for the young of the same species, and milk of another species is the next best food for the nutrition of young mammals. The milk of any species of animal, provided it is palatable, is also an eminently suitable food for human beings, especially during growth, pregnancy and lactation.

Cows' milk contains protein, fat and carbohydrate, all the known vitamins and a variety of mineral elements necessary for normal nutrition. It is the most valuable food known for the promotion of growth and health in children. The present consumption of liquid milk is about 0·4 pint per head per day: if the average consumption could be increased to one pint, there would result an improvement in the general health of the community, especially in the case of children, in whom it would secure better bone formation and improvement in stature and physique. The incidence of disease, including rickets, would be diminished and the resistance to dental caries increased.

The few disadvantages of milk as an article of diet can be easily overcome: for infants it should be supplemented with iron and vitamins C and D. Children and nursing and expectant mothers should take about two pints a day: other adults should consume not less than half a pint a day, to ensure an adequate intake of calcium. The only significant changes effected in the composition of milk by heat are a partial loss of vitamin C and possibly of iodine: these deficiencies can be made good in the diet of babies fed exclusively on cows' milk by the addition of fruit or vegetable juice and cod liver oil, and in a mixed diet by potatoes or other vegetables or fresh fruit and some sea fish. Unless the milk comes from perfectly healthy cows, it should be boiled or pasteurised before use. Separated milk has a high nutritive value since it contains the bulk of the essential dietary constituents found in whole milk: whey, on the other hand, is a less complete food but would add considerably to the nutritional value of a diet containing cereals and cereal products.

* The Nutritive Value of Milk: Memorandum by the Advisory Committee on Nutrition. Issued by the Ministry of Health and the Department of Health for Scotland. Pp. 12. (London: H.M. Stationery Office, 1936.) 3d. net.

## Educational Topics and Events

CAMBRIDGE.—The following grants have been authorised from the Anthony Wilkin Studentship Fund: £40 to J. R. B. Stewart, of Trinity Hall, to enable him to continue the excavations he is doing near Balikiser in Asia Minor; £40 to G. E. Daniel, of St. John's College, for the investigation of a megalith in South Wales.

In the report of the Buildings Syndicate on the completion of various building schemes undertaken in connexion with the Rockefeller benefaction for the physical and biological sciences, it is stated that the total cost amounted to £196,858.

At St. John's College the following have been elected into fellowships: E. H. F. Baldwin, H. Carmichael and J. S. Mitchell.

EDINBURGH.—Dr. A. L. Craig-Bennett, of the Department of Zoology, has been appointed by the Colonial Office to be chief fisheries officer in Palestine.

SHEFFIELD.—The following appointments have recently been made: Mr. Glyn Davies, to be lecturer in obstetrics and gynæcology; Mr. J. C. Paisley, to be junior assistant bacteriologist; Mr. A. J. Holland and Mr. N. A. Nichols, to be research assistants in the Department of Glass Technology.

IT is announced by the Lisbon correspondent of *The Times* that the honorary doctorate of the Technical University of Lisbon has been conferred on Sir Josiah Stamp, president of the British Association. Sir Josiah has presented to the University Library the original letter from a Lisbon merchant to his principal in England describing the effects on his business of the great earthquake of 1755; also a book containing some English publications of the period describing the earthquake. In return Sir Josiah was presented with a copy of the Lusiads by Camoens in a silver casket. It is stated that this is the first honorary doctorate to be conferred on an Englishman.

Two fellowships (70[illegible] dollars), eleven studentships (600 dollars) and [illegible]venteen bursaries (500 dollars) have been awarded for the year 1936–37 by the National Research Council, Ottawa, to candidates selected from Canadian universities. The policy of assisting exceptional students to pursue post-graduate work in Canadian universities has been followed since the inception of the Council, the object being to build up in Canada a supply of well-trained men of science capable of undertaking and carrying through research investigations involving a more profitable utilisation of Canadian raw materials and the expansion of markets for Canadian products.

THE education of girls in India has in recent years passed through a phase of tumultuous changes. Its backward state made such an impression on the Indian Statutory Commission that it was declared in an Interim Report (generally referred to as the Hartog Report) "priority should now be given to the claims of girls' education in every scheme of expansion". In a paper to the Indian Section of the Royal Society of Arts (*J. Roy. Soc. Arts*, March 20), Lady Hartog estimated the extent and character of the developments that have followed the publication of that Report. Whereas the Committee found that the disparity in numbers as between boys and girls at school, about 5 to 1, was increasing by more than 350,000 a year, the next few years were marked by such a rush of girl pupils alike to primary school, secondary school and college, that by 1932–33 their annual increment was exceeding that of boy pupils by more than 100,000. The gratification with which this advance has been received should not, Lady Hartog pointed out, obscure the fact that it has been accompanied by serious abuses. In the primary schools almost 40 per cent of the girl pupils are, for lack of girls' schools, accommodated in boys' schools, where they have no real place in the school life. There are, as a rule, no women teachers and no provision for teaching the girls anything outside the boys' curriculum. Of all the primary schools for girls in India, Bengal possesses nearly half, and in this province so inefficient is their instruction that the whole system of girls' primary schools is condemned as, with a few exceptions, practically useless. In the secondary schools the position is not so bad. Though overcrowded, the buildings are on the whole good, and it is beginning to be recognised that the curriculum, instead of being a replica of that of the boys, should have some relation to the home life which will be the lot of the vast majority of the girls. In the universities, the influx of girls has been justifying itself by results, especially in the medical schools; but there is said to be a crying need for more women's colleges and hostels.

## Science News a Century Ago

### Registration of Statistics

ON May 16, 1836, at a meeting of the Statistical Society, the Right Hon. Holt Mackenzie read a paper entitled "Observations on the means of collecting information on various points of Statistics, explanatory of a proposition for the appointment of a Committee to consider the expediency of opening books for the contemporary record of various statistical facts, and to prepare the forms in which such books shall be kept". Mr. Mackenzie said, that everyone who had attempted to prosecute statistical inquiries relating to past ages, must have been struck with the difficulty of getting fully and accurately, for any considerable series of years, information relating to things, which, at the time of their occurrence, were known to all the world, and he suggested that the Society should do for posterity what we wish our ancestors had done for us, or in other words, realise the probable wishes of the men of the year 2000. In accordance with his scheme, he therefore suggested that a set of registers should be opened to contain statistics relating to prices, wages, earnings, salaries, fees, weights and measures, coinage, interest, dividends, exchanges, insurance and income and expenditure of different classes of society, etc.

### Observations of the Solar Eclipse

AMONG those who observed the annular solar eclipse of May 15, 1836, was J. D. Forbes, who on May 17 wrote from Edinburgh to Quetelet at Brussels: "On the 15th the solar eclipse was most admirably seen here. . . . I observed with a 7-feet reflector the immersion and emersion of the spots, of which there were several, but I could not observe the slightest distortion produced by refraction upon those delicate objects. My attention was chiefly directed to this

object: to examine the light from the sun's edges, at and near the annular period, in order to ascertain whether the dark lines in the spectrum were more numerous or stronger in the light which must have traversed the greatest thickness of the sun's atmosphere, and which have been supposed by Sir D. Brewster and others to be due to the absorptive action of that atmosphere. An attentive examination assures me that no material difference could exist; indeed, I did not perceive the slightest." Writing to Miss Forbes four days later, he said: "The eclipse was admirably seen here, and seemed to strike every sort of person much more than expected. I was making optical experiments in a dark room most of the time, but ran out for half a minute to see the ring, which was a wonderful sight. I sent you an account in the *Advertiser*. Dr. Chalmers preached, and I managed to hear him, too. Evening service was postponed in the churches and chapels, except Mr. Bagot's, and the smoking of glass and the burning of fingers and blacking of faces was wonderful. . . ."

### Glass Balance-Springs in Chronometers

AT a meeting of the Royal Society held on May 19, 1836, Captain F. Beaufort, R.N., communicated a paper by Arnold and Dent "On the Application of Glass as a substitute for metal balance-springs in Chronometers". In their endeavour to determine and reduce the errors arising from the expansion and contraction of balance-springs in chronometers due to the variations in temperature, glass had been suggested as possessing desirable qualities. It was found that a glass balance-spring would resist the effect of cold, and by experiments made on board H.M.S. *Excellent* at Portsmouth that it would withstand the shock arising from the discharge of cannon in the vicinity. "On comparing the performance of glass balance-springs with metallic ones when the temperature was raised from 32° to 100°, it was found that while the loss in twenty-four hours in the gold springs was 8 m. 4 s., that of steel 6 m. 25 s. and that of palladium 2 m. 21 s., that of a glass spring was only 40 s." Chronometers with glass balance-springs were being tested at the Royal Observatory.

### Death after Flogging

THE *Gazette des hôpitaux* of May 20, 1836, contains the following report: "A jury met at the King's Head Tavern, Woolwich, to inquire into the death of a sailor named William Saundry who died after being flogged. According to the coroner, the case required much consideration, as it had to be decided whether death was the result of a military punishment or of some disease. Death had occurred ten days after the flogging. The autopsy ordered by the coroner took place in the presence of ten doctors who decided that death was the result of fever and not of the flogging. Eight of the jury maintained that death would not have taken place without the flogging, but nine of the others agreed with the opinion of the doctors. The following verdict was given: 'William Saundry died by the visitation of God, and not by the hand of a person of any kind'. On reading a report of this case, it is difficult to say which is the most astounding: the contradictions in the report, the intense partiality of the doctors or the existence of so barbarous a punishment in a country so highly placed in the scale of civilisation as England."

# Societies and Academies

## LONDON

Royal Society, May 7. P. M. S. BLACKETT: Measurement of the energy of cosmic rays. (1). The electromagnet and cloud chamber. An electro-magnet weighing about 11,000 kgm. has been constructed for the purpose of measuring the energy of cosmic rays and for studying the cosmic ray showers. The magnet gives a field of 14,000 gauss in a gap of 15 cm. between pole pieces 25 cm. in diameter for a power of 25 kw. The coils are air-cooled using a 4 h.p. fan. A special cloud chamber, 27 cm. in diameter by 3 cm. deep, is placed between the pole pieces. Two different optical systems are used, one employing a mirror and a camera at the side, and the other employing a stereo-camera photographing through a hole in one pole piece. The various arrangements of gap and optical system are compared from the point of view of measuring cosmic rays of the greatest possible energy. P. M. S. BLACKETT and R. B. BRODE: The measurement of the energy of cosmic rays. (2). The curvature measurements and the energy spectrum. The measurement of the energies depends on the measurement of very small curvatures. The method of making these measurements is described. Measurements of 180 cosmic ray tracks are given. The highest detectable energy with tracks 17 cm. long in 14,000 gauss is $2 \times 10^{10}$ e.v. The energy spectrum between $10^9$ and $10^{10}$ e.v. is shown to be approximately of the form $g(E) \propto E^{-2}$; in this range of energies about equal numbers of positive and negative particles are found. The particles over $10^{10}$ e.v. are mainly positive. W. EHRENBERG: The connexion between cosmic ray showers. Cosmic ray showers have so far been investigated chiefly by counting the number of triple coincidences of suitably arranged Geiger-Müller counters. The information obtained in this way is restricted to the number of these events. To obtain more complete information on showers, an ionisation chamber was put above the counters in the experiments described, and the ionisation in the chamber was recorded whenever all three counters were operated simultaneously. This ionisation is due to the shower particles traversing the chamber, and the number of ions produced is proportional to the number of particles in the shower. The number of particles in showers obtained under different conditions varies between 3 and 1,200. With lead above the chamber the rate of occurrence $R$ of showers of $N$ particles decreases rapidly with $N$, following approximately a law $R = N^{-s}$ where $s$ lies between 2·2 and 3·1. It is concluded that all 'bursts' are nothing else than showers measured by the ionisation they produce. D. H. FOLLETT and J. D. CRAWSHAW: Cosmic ray measurements under thirty metres of clay. The zenith angle distribution of cosmic ray intensity in a north-south plane was determined at ground-level and in Holborn Underground station. At this level the vertical intensity was approximately 1/20 that at ground level. The shape of the distribution curve is the same at the two levels. This leads to the conclusion that the intensity of cosmic radiation varies as a power of the path length in an absorber, rather than exponentially; and the shape of the curve gives the value $-2$ for this power. Using five counters, so arranged that at least three particles arriving simultaneously are required to discharge all five at once, the presence of showers in the Underground station was proved. Rough

transition curves were taken, at that level and at ground-level; they had approximately the same shape, with a maximum at the neighbourhood of 1·6 cm. of lead. The ratio of shower frequency to vertical intensity is apparently not very different at the two levels (see also NATURE, Dec. 28, 1935, p. 1026).

### PARIS

Academy of Sciences, April 6 (*C.R.*, 202, 1225–1316). EMILE JOUGUET: The waves of shock produced in a gas by a solid explosive. ARMAND DE GRAMONT and DANIEL BERETZKI: The generation of acoustic waves by means of piezo-electric quartz. Description of arrangements by means of which vibrating quartz plates can be made to give a range of 50–30,000 periods per second. LOUIS ROY: Remarks on the new Giorgi system of units. A. DEMOULIN: The curvature of congruences of spheres. PIERRE RACHEVSKY: Trimetric systems and the generalised Finsler metric. CASIMIR KURATOWSKI: A problem concerning transfinite induction. STÉFAN KEMPISTY: The Denjoy-Stieltjes integral of a function of two variables. EUGÈNE LEIMANIS: The singular points of differential equations. I. PETROWSKY: A problem of Cauchy for a linear system of partial differential equations in a real domain. BÉLA de Sz. NAGY: The invariant measurement in topological groups. LEONIDAS KANTOROVITCH: The general forms of the linear operations which transform some classic spaces into an arbitrary linear semi-ordinate space. LÉOPOLD ESCANDE and GEORGES SABATHE: Experiments on piers of weirs with aerodynamic profile and zero contractions. EDMOND BRUN, MARCEL JAMPY and ROBERT LECARDONNEL: The thermal exchanges between a heated body and the air when the body has a high velocity with respect to the fluid. BERNARD LYOT: The solar corona in 1935. Results of observations, direct and spectroscopic, made at the Pic du Midi during August and September, 1935. PIERRE SALET: The kinetic energy of the stars. G. FOURNIER: Some seasonal phenomena presented by the planet Mars during 1935. JACQUES WINTER: The polarisation of Dirac waves. RENÉ PLANIOL: The production of intense bundles of slow electrons. PIERRE JOLIBOIS and FRANÇOIS OLMER: The synthesis of ammonia by cathodic pulverisation of lead. Catalysis by cathodic projection establishes equilibrium of such a system as $N_2+3H_2$ at very low temperatures (38°–118° C.) compared with those required in the absence of catalysts. L. NÉEL: An attempt at the interpretation of the saturation moment of ferromagnetic metals. MAURICE DÉSIRANT and ANDRÉ MINNE: The bands of fluctuations of tellurium vapour. SALOMON ROSENBLUM, MARCEL GUILLOT and MLLE. MARGUERITE PEREY: The intensity of the groups of fine structure of the α-magnetic spectra of radioactinium and its descendants. LOUIS DOMANGE: The equilibria of some metallic fluorides with steam. Experimental data obtained with the fluorides of ten metals. C. DEGARD: Study of the structure of the molecule of nitromethane by diffraction of electronic rays in the vapour. JEAN LOUIS DELSAL: The polarimetric study of nickel malate. MLADEN PAIĆ and MLLE. VALERIE DEUTSCH: The adsorption of proteins. The influence of the hydrogen ion concentration on the adsorption of hæmoglobin by kaolin. FRANÇOIS PUCHE: Barium chlorosmate. Preparation, properties and thermal dissociation of $BaOsCl_6$. ROBERT TRUFFAULT: The condensation of benzene with unsaturated hydrocarbons and with their halogen derivatives in the presence of acid catalysts. Allyl chloride and benzene, in the presence of concentrated acid as catalyst, react to give β-chlorisopropyl benzene. PANOS GRAMMATICAKIS: The action of organo-magnesium compounds on the phenylhydrazones. Method of preparation of the symmetrical alkylphenylhydrazines. ALBERT ROBAUX: The presence of the upper Cretaceous in the Palæozoic of the Betic of Malaga (Andalusia). LOUIS LONGCHAMBON: The bituminous schists of Fécocourt. PIERRE DANGEARD: The somatic nuclear division in *Arum italicum*. LUC ALABOUVETTE, LÉONIDE FRIEDBERG and PIERRE BERGAL: Some utilisable characters for the separation of pedigree kinds of two-rowed barley, *Hordeum distichum*. JEAN GRYNFELTT: The crystalloids of the mammary gland. J. GAUTRELET, D. BROUN, H. SCHEINER and EL. CORTEGGIANI: The characterisation of sympathico and parasympathicomimetic substances in blood by dialysis *in vivo*. RAOUL LECOQ: Production of bird polyneuritis by means of diets rich in glucides, proteins and lipids, including large doses of B vitamins by simple addition of lactic acid. The addition of 10 per cent of lactic acid prevents the pigeon utilising vitamin B, even when the latter is present in high proportions. ANTOINE JULLIEN and MME. HÉLÈNE VAIREL-BLANC: The relations between the automatic activity of the heart and the structure of the organ in the snail. MME. ANDRÉE DRILHON and E. A. PORA: Ionisation and buffers of the internal medium of the crab (*Carcinus mœnas*) with parasite (*Sacculina*). MAURICE FONTAINE: The complete maturing of the genital organs of the male eel and the spontaneous emission of its sexual products. MICHEL CIUCA, MME. LYDIA MESROBEANU and GEORGES BADENSKI: Microbial variants of the Aertrycke bacillus and possible variability in the chemical constitution of the complete somatic antigen of this germ.

### ROME

Royal National Academy of the Lincei (*Atti*, 22, 367–472; 1935). M. BETTI and E. LUCCHI: Anomalies in the dissociation constants of some halogenated organic acids (3). The dissociation constants of o-chloro- and o-bromocinnamic acids (*trans*) are equal ($0·39 \times 10^{-4}$). F. SACCO: Transversal tectonic lines of the Appennines (1). R. CACCIOPPOLI: (1) Elliptical partial differential equations with two independent variables, and regular problems of the calculus of variations (ii). (2) Conformable representation and quadrable surfaces. G. SCORZA DRAGONI: Concerning a theorem of Golomb on non-linear integral equations. B. SEGRE: (1) Curvilinear elements which have common origins and relative spaces meeting at a point. (2) Projective lines and an immersion invariant of a curve on a surface. E. GUGINO: Relativistic problem of motion in a stationary gravitational field. L. SONA: Translocirculatory current which invests a bilateral lamina. Dynamic forces (4). G. BISCONCINI: On the so-called gyroscopic phenomena. L. USLENGHI: Motion of a point source in a concave angle. A. MASOTTI: (1) Centre of asymptotic motion. (2) Planar motions in presence of particular systems of vortex-sources. S. FRANCHETTI: Liquid state and interatomic forces (1). G. B. BONINO and R. MANZONI-ANSIDEI: Raman spectrum and constitution of pyrazole and of some of its derivatives. The spectrum of pyrazole contains eleven lines, similar to those of thiophen and of pyrrole, but there are no lines characteristic

of the double-bond. R. MANZONI-ANSIDEI : Raman spectrum of dimethylfurazan and of dimethyloxdiazole. G. B. BONINO, R. MANZONI-ANSIDEI and D. DINELLI : Raman spectrum of some substituted pyrrole aldehydes. These all have an intense, diffuse line at 1,620–1,650 cm.$^{-1}$ due to the strongly perturbed C=O group, and a line at 1,560–1,570 cm.$^{-1}$, which is probably due to a double bond. A. MANGINI : Condensation products of oximes with aromatic diazo compounds. A. ORRÙ : Behaviour of the electrical conductivity of hen's egg yolk at increasing and decreasing temperatures. There is no hysteresis phenomenon in the case of egg yolk. D. DINELLI : Colouring substances in the shell of cassowary eggs. M. FIORE : Presence of *Wielandiella angustifolia*, Nath., in Veronese Lias (Roverè di Velo). F. RODOLICO : Chemical composition of the eruptive rock of Cupaello (Rieti).

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Monday, May 18

VICTORIA INSTITUTE, at 5.—Sir Ambrose Fleming, F.R.S. : "Some Philosophical Conceptions of Modern Physical Science and their Relation to Religious Thought". (Presidential Address.)

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.30. —Dr. H. M. Traquiar : "Perimetry" (succeeding lecture on May 19).*

KING'S COLLEGE, LONDON, at 5.30.—Dr. Max Born : "Solved and Unsolved Problems of Mathematical Physics" (succeeding lectures on May 19 and 20).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. N. A. Mackintosh : "The Third Commission of R.R.S. *Discovery II*".

### Tuesday, May 19

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. W. Munro : "Insect Damage to Empire Products".

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. J. L. Witts : "The Paroxysmal Hæmoglobinurias".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. Ernst Cassirer : "Leibniz and Newton : a Comparative Study of the Method of Science and Metaphysics" (succeeding lecture on May 21).*

### Wednesday, May 20

CONWAY HALL, RED LION SQUARE, W.C.1, at 7.—Prof. Lancelot Hogben : "The Retreat from Reason" (Conway Memorial Lecture).*

### Thursday, May 21

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Alfred Adler : "Some Recent Developments in Individual Psychology".*

ROYAL AERONAUTICAL SOCIETY.—(at the Science Museum, South Kensington, S.W.7).—D. R. Pye : "Slippery Surfaces" (Wilbur Wright Memorial Lecture).

### Friday, May 22

ASSOCIATION OF SCIENTIFIC WORKERS, at 8.—(at University College, London, W.C.1).—Public meeting on "Utilisation of Science".*

ROYAL INSTITUTION, at 9.—Prof. E. N. da C. Andrade, F.R.S. : "Whirlpools and Vortices".

## Official Publications Received

### Great Britain and Ireland

Reports of the Council and Auditors of the Zoological Society of London, for the Year 1935, prepared for the Annual General Meeting to be held on Wednesday, April 29th, 1936. Pp. 119. (London : Zoological Society of London.) [154

University College, Southampton. Avon Biological Research : Annual Report, 1934–35. Pp. 126+3 plates. (Southampton : University College.) 2*s*. 6*d*. [154

University Grants Committee. Report for the Period 1929–30 to 1934–35, including Returns from Universities and University Colleges in receipt of Treasury Grant for Academic Year 1934–35. Pp. 84. (London : H.M. Stationery Office.) 4*s*. net. [164

Sixth Report on the Heterogeneity of Steel Ingots : Discussion, Correspondence and Committee's Reply. Reported by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. (Special Report No. 9A : Supplement to Special Report No. 9.) Pp. ii+70. (London : Iron and Steel Institute.) [164

Waste-Heat Boilers in Open-Hearth Practice : Discussion, Correspondence and Committee's Reply. Second Report of the Open-Hearth Committee, being a Committee of the Iron and Steel Industrial Research Council. (Special Report No. 10A : Supplement to Special Report No. 10.) Pp. ii+63. (London : Iron and Steel Institute.) [174

Ministry of Health. International Agreement Brussels, 1924 : Venereal Diseases. Centres in the Ports at Home and Abroad where Seamen can obtain Treatment. (List 7a, revised.) Pp. 25. (London : H.M. Stationery Office.) 6*d*. net. [174

### Other Countries

Beiträge zur Mineralogie von Japan. Begründet von T. Wada. Neue Folge, 1. Herausgegeben von T. Ito. Pp. vii+xviii+259. (Tokyo : Imperial University.) [204

Commonwealth of Australia : Council for Scientific and Industrial Research. Bulletin No. 94 : Fertility in Sheep ; Artificial Production of Seminal Ejaculation and the Characters of the Spermatozoa contained Therein. By Dr. R. M. C. Gunn. Pp. 116. Bulletin No. 95 (Radio Research Board Report No. 9) : 1. A Study of the Magneto-Ionic Theory of Wave Propagation by means of Conformal Representation, b Dr. V. A. Bailey ; 2. Dispersion and Absorption Curves for Radio Wave Propagation in the Ionosphere according to the Magneto-Ionic Theory, by Dr. D. F. Martyn ; 3. A Temperature Compensated Dynatron Oscillator of High Frequency Stability, by J. H. Piddington ; 4. The Amplification of Programme Transients in Radio Receivers, by Dr. Geoffrey Builder ; 5. A Multi-Range, Push-Pull, Thermionic Voltmeter, by Dr. Geoffrey Builder ; 6. The Graphical Solution of Simple Parallel-Tuned Circuits, by Dr. Geoffrey Builder ; 7. An Electrical Harmonic Analyser of the Fundamental Suppression Type, by J. H. Piddington. Pp. 71. Pamphlet No. 61 : A Discussion of Special Tests on the Compressive Strength of Green Karri (*Eucalyptus diversicolor*). By Ian Langlands. (Division of Forest Products, Technical Paper No. 19.) Pp. 31. (Melbourne : Government Printer.) [204

Zoologica. Vol. 21, Part 1, Nos. 1 and 2 : The Reproductive Habits of the North American Sunfishes (Family Centrarchidae), by C. M. Breder, Jr. ; Polychaetous Annelids from the Vicinity of Nonsuch Island, Bermuda, by A. L. Treadwell. Pp. 68+10 plates. (New York : New York Zoological Society.) [204

The Imperial College of Tropical Agriculture. The Principal's Report for the Year 1934–35 and the Accounts for the Year ended August 31, 1935. Pp. 34. (Trinidad and London : Imperial College of Tropical Agriculture.) [234

Field Museum of Natural History. Report Series, Vol. 10, No. 3 : Annual Report of the Director to the Board of Trustees for the Year 1935. (Publication 354.) Pp. 281–416+plates 25–36. (Chicago : Field Museum of Natural History.) 1 dollar. [244

University of Nebraska : Conservation Department of the Conservation and Survey Division. Bulletin 12 : Relative Efficiency of Roots and Tops of Plants in protecting the Soil from Erosion. By Joseph Kramer and Prof. J. E. Weaver. (Contribution from the Department of Botany, No. 99.) Pp. 94. (Lincoln, Nebr. : University of Nebraska.) [244

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 68 : A Monograph of the Belgian Cretaceous Echinoids. By Jerome S. Smiser. Pp. 98+9 plates. No. 71 : Die Plistozaenen Baeren Belgiens. Teil 2 : Die Baeren vom "Trou du Sureau" (Montaigle). Von Prof. Dr. Kurt Ehrenberg. Pp. 97+6 plates. No. 73 : La faune et l'âge des quartzophyllades siegeniens de Longlier. Par Eug. Maillieux. Pp. 141+3 plates. Deuxième Série, Fasc. 1 : Étude systématique du genre Lepocinclis Perty. Par Dr. W. Conrad. Pp. 85. Deuxième Série, Fasc. 2 : Hydraires calyptoblastiques des Indes occidentales. Par Dr. Eugène Leloup. Pp. 75. (Bruxelles : Musée Royal d'Histoire Naturelle de Belgique.) [244

American Philosophical Society. Library : Annual Report for 1935. Pp. 18. (Philadelphia : American Philosophical Society.) [274

Rensselaer Polytechnic Institute Bulletin. Engineering and Science Series, No. 52 : The Dielectric Constant of Mineral Powders. By Joseph L. Rosenholtz and Dudley T. Smith. Pp. 11. (Troy, N.Y. : Rensselaer Polytechnic Institute.) [274

*Commonwealth of Australia : Council for Scientific and Industrial* Research. Bulletin No. 96 : Observations on *Myxomatosis Cuniculi* (Sanarelli) made with a view to the use of the Virus in the Control of Rabbit Plagues. By Sir Charles J. Martin. Pp. 28. (Melbourne : Government Printer.) [274

Sixteenth Annual Report of the Research Council of Alberta, 1935. (Report No. 33.) Pp. 44+5 plates. (Edmonton, Alba. : Research Council of Alberta.) 35 cents. [274

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 137 : Boundary Interference of Partially Closed Wind Tunnels. By Kazuo Kondo. Pp. 162–190. (Tôkyô : Kôgyô Tosho Kabushiki Kaisha.) 30 sen. [254

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# Organisation of Radio Research in India

IT is a well-established axiom to-day that progress in all branches of scientific knowledge can only be maintained by the conduct of intensive fundamental research, as well as by the continued developments in the application of the particular field of science under consideration. In many fields this type of research can be carried out within the confines of the ordinary scientific laboratory. Research into the fundamental problems of radio communication, however, can scarcely be limited in this way, since many of the investigations require to be conducted in a laboratory of world-wide dimensions, and considerable resources and much co-operation are necessary in order to stage the experimental work on an adequate basis. Such considerations as these have led to the establishment of national radio research boards, the first of which was formed in Great Britain in 1920, while others have followed in Australia and Canada. The time would now appear to be very opportune for considering the establishment of a similar Radio Research Board in India, where fundamental research in radio communication has so far been limited to the activities of quite small bands of workers in different universities, notably those under Prof. S. K. Mitra at Calcutta and under Prof. M. N. Saha at Allahabad.

To those interested in the general progress of radio communication, whether from a scientific or commercial point of view, there would appear to be a strong case for the establishment of such a research organisation. The tropical climatic conditions of India are likely to have a considerable influence upon the production, propagation and reception of the electric waves used in radio communication, and the effects to be expected are not easily predictable from the knowledge that has been gained from research conducted under the more equable conditions of Great Britain. The phenomena of the propagation of waves along the ground and through the atmosphere can only be investigated adequately on the spot, while the proximity of India to the seat of intense atmospheric disturbances will have a considerable influence on wireless reception.

Many of these problems are of interest for their own sake: they will most certainly be of great interest to those who have already gained considerable knowledge from similar work under other radio research organisations; but in addition to this, the knowledge gained from the successful attack on these problems will be of the greatest importance to those responsible for the development of radio communication in India, for broadcasting and other purposes. In some ways, the development of radio stations for ordinary telegraphic and telephonic purposes in India has been carried to a moderately satisfactory stage, largely due to the very active assistance rendered by the appropriate administrations in Great Britain. Even in this sphere, however, it must not be considered that progress and development are by any means complete.

It is in the field of broadcasting, however, that noteworthy developments appear to be likely. The population of India is in the order of 350 millions, of whom it is estimated that only about 12,000 are registered broadcast listeners. With the full realisation that a large proportion of broadcast listening among the masses is likely to be on a communal basis, it is perhaps not an overestimate to suggest that the number of potential

purchasers of broadcast receivers is of the order of three and a half millions. There is an attractive market to the manufacturer of receivers, which must naturally be adapted to the conditions, climatic and other, under which they would be required to function in India.

Before consideration can usefully be given to this aspect, however, it is necessary that a radio broadcasting service shall be provided in India on an adequate scale, and Mr. K. Sreenivasan, of the Indian Institute of Science, Bengalore, has already described in some detail the type of organisation which is required for this purpose (see NATURE, Aug. 10, 1935, p. 231). Such a broadcasting organisation would derive considerable benefit from the establishment of a Radio Research Board, with which it could co-operate in the conduct of many of the fundamental problems underlying its technical service. Indeed, in so far as the British Broadcasting Corporation is already providing a part of its Empire service for English-speaking residents in India, a local organisation which could investigate and give advice upon the problems of reception in India would most certainly be welcomed by the broadcasting authorities in Great Britain.

The benefits to be derived from a new organisation of the type under discussion are most clearly appreciated from a brief review of the work of those radio research boards already in operation.

In Great Britain, the Radio Research Board was established in 1920 under the Department of Scientific and Industrial Research. It comprises representatives of all Government departments interested in radio communication, namely, the defence services, the Post Office and the British Broadcasting Corporation, and in addition, there are one or two university members who have attained high standing in radio research. The research work is conducted largely at the National Physical Laboratory, but in part also at universities under the general supervision of a number of technical committees appointed by the Board. The programme of research for the most part may be classified under the headings of propagation of electric waves, directional wireless, atmospheric disturbances and the development of apparatus and technique for standardisation and measurement.

Much of the work of the Radio Research Board involves resources which are quite beyond those of any university or even of any commercial organisation or self-contained Government department engaged upon a specific aspect of communication. The Radio Research Board combines the advantages for its staff of freedom from the continued stress of direct commercial application of the results of their work, with the co-operation which is obtainable from those who utilise radio communication in one or more of its many aspects. This co-operation is readily provided because the user administrations realise that the results of the research will frequently be of direct benefit to them in their own work. Further, the operation of such a research board provides a team of trained experts, whose advice and experience is readily available in connexion with the many problems arising in the progress of radio communication. In some cases the organisation has been regarded as a source of trained personnel for industry.

The Australian Radio Research Board began in 1926, with all the benefits of the experience of the British organisation, and indeed, many members of its staff were trained under the British Radio Research Board. Canada entered the field in 1930 with a committee appointed under its National Research Council.

While these research organisations overseas deal with particular radio problems which are local to their countries, they also conduct programmes of research which are very similar to that mentioned above in progress in Great Britain. This is the result of what is considered to be an important feature of the British Board, in that it recognises the Imperial aspect of the problems with which it has to deal; it is thus always ready to co-operate fully with the Boards of the Dominions Overseas, not only by suggesting a common and suitable programme of work, but also by giving freely of the advice and experience of its staff, and even in some special cases by the supply of necessary apparatus.

It is surely time that India was able to take its place in such a world-wide scheme, and it is to be hoped that those in a position to do so will foster the inauguration of a suitable Radio Research Board and provide the necessary funds to initiate its work. The research already carried out in India indicates that the universities are ready to provide a programme of problems of a fundamental nature, and even the nucleus of a staff of trained personnel, keen and enthusiastic to continue their investigations, which are at present being limited through lack of resources.

# 'Out of the East'

**Soviet Communism:**
a New Civilisation? By Sidney and Beatrice Webb. Vol. 1. Pp. xix+528. Vol. 2. Pp. x+529-1174. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 35s. net.

IT may seem a little late to be embarking upon a review of Mr. and Mrs. Sidney Webb's (one must defer to their own designation of themselves) book on communism in the Soviet State. But it is not a book to be treated in the hasty way of ordinary reviewing; it has to be read. Still more, it possesses the character of a monument, and one needs to stand back from a monument in order to appreciate it properly.

The book, one hears, is the outcome not merely of two personal visits to Russia and a wealth of documentary study, but also of many inquiries and journeys by other observers. But the Webbs have taken upon themselves the task of reducing the mass of material thus accumulated into form, and have produced not a digest but a living book, vital with that sustained passion for human progress which has marked the whole lives of these two great workers. *Pour faire quelquechose de grand il faut être passionné.* We can only bow in respectful admiration to the man and woman who have carried through such an undertaking when both are nearing their eightieth year.

The first volume is occupied by a description of the form of government and administration within the Soviet Republic. The most usual criticism is that the Soviet State has only replaced the old Russian autocracy by a new tyranny, even by a dictatorship, at first in the person of Lenin, now of Stalin. In their sixth chapter the Webbs have an interesting discussion on the point, whether dictatorship can be attributed to Stalin or the Communist Party itself. Stalin holds but a subordinate position in the Government, and a reply of his to the effect that "Single persons cannot decide. The decisions of single persons are always or nearly always one-sided decisions" is contrasted with a remark of Mussolini's: "I am an individual absolutely refractory to outside pressure of any kind". Possibly either statement aimed as much at effect as the whole truth, but there is evidence in justification of both.

The earlier chapters are devoted to explaining how the Government is built up as a pyramid of soviets based upon the popularly created village and city soviets; they in their turn send delegates to the rayons, above which are the oblasts, including the twelve autonomous republics. The next tier of councils is that of the seven constituent republics, of which by far the greatest is the Russian Socialist Federal Soviet Republic with its capital at Moscow, and at the top comes the U.S.S.R., the Soviet State proper. "From top to bottom of this pyramid of councils, each tier has complete authority over all below it, and is itself completely subject to all above it". While the village soviets are elected on ordinary lines, in the cities the electoral groups are not wards or districts but institutions like factories or offices. "The actual unit of the electorate in the urban communities of the U.S.S.R. is everywhere a relatively small assemblage of persons, usually a few hundreds and seldom exceeding one thousand, who, wherever they reside, or whatever their grade, or industrial status, or particular craft, or vocation, are for the most part habitually meeting each other in daily work".

Men and women become voters at the age of eighteen, but there is a 'deprived' class which may neither vote nor be elected. This includes rentiers, clergymen, employers of labour working for their own profit, commercial agents, imbeciles and certain classes of criminals. But the 'deprived' class, once perhaps ten per cent of the electorate, has been shrinking, and is to disappear when the new law of elections comes into action. The writers insist on the entire freedom of election and on the play of discussion on persons and projects which persists throughout all the grades; they hold that in fact government, from the village soviet to the Sovnarkom or Cabinet, proceeds through committees and is neither autocracy nor bureaucracy. Again the Webbs give examples to show the participation of the people at large in the business of government, due in part to the smallness and intimacy of the initial Soviet groups. For the time being, at any rate, there is none of that apathy about voting which characterises our municipal and district council elections.

Of immense importance are the relations between the central power and the various nationalities in the vast area of what is no longer Russia but the Soviet Republic, itself made up of seven constituent republics which include other autonomous republics and oblasts, each representing a 'nationality'. The old drive for 'Russification' has been abandoned; instead, the republics participate in an 'un-national State' but exercise control of language, religion, education and economic development within their own areas.

The national unit may be as large as the Ukraine with thirty million inhabitants, or as small as the Volga German Republic with six hundred thousand ; even the Jewish community at Biro-Bidjan needs but a little more population to become recognised as an autonomous republic.

The principle is thus to allow each national group control of its own imponderables, so much so that in the authors' opinion "the Soviet Union, alone amongst the countries of Eastern Europe, can claim, with a high degree of accuracy, that it has solved the difficult problem presented by the existence of national minorities within a strongly centralised state". Doubtless also some unifying effect comes from the liberation accompanying the Revolution, just as the French Revolution united for ever national groups as diverse as the Bretons and the Alsatians or the Catalans and the Basques. There are, however, limits to the autonomy ; the national groups may not enter into relations with fellow nationals outside the U.S.S.R. ; there can be no Nazi propaganda within the Volga German Republic. "The local authorities could give preference to their own nationals as teachers and local officials and were even encouraged to do so. Their religious services were not interfered with by the Central Government. They could establish theatres, and publish books and newspapers in their own tongues. These were exactly the matters in which local autonomy was most desired". But the Federal Government, the Soviet State proper, retains certain powers within which all Governments must work ; for example, foreign relations, the armed forces, transport and communications, currency and State loans are reserved. Even more important reservations are the definition of citizenship, the monopoly of all external trade, and the "foundations of the whole people's economy", which means the elimination of the capitalist and the landlord as receivers of profit from organised labour, which indeed constitutes the spiritual basis of the Soviet Union.

An important chapter discusses the position of the Communist Party, that order or vocation numbering only some three million men and women, which has no place in the constitution but which pervades the whole life of the country. Members are admitted only after probation, and may be expelled for any failure to live up to the standard of personal conduct that is set ; they must accept a limitation of income and absolute discipline to be sent hither and thither wherever the Party thinks stimulus or organisation is needed. But they can obtain administrative power only by election to the Soviets, otherwise they work by propaganda and influence. The Party may be compared to a religious order like the Jesuits ; its vocation is leadership ; its driving power is derived from "the impulse of a faith—which communists will not allow us to call a new religion, but which has all the impelling force that religions have elsewhere possessed". "In fact in the nature of its mentality, as in the direction of its activities, the Communist Party reminds us less of a religious order than of the organisation of the learned professions of Western Europe, such as those of the lawyers and doctors, engineers and public accountants. Like these and many other professional bodies, the Communist Party concerns itself exclusively with the affairs of this world".

These political sections of the book merit the earnest consideration of all students of government and administration. We are conscious that with the increased complexity of modern life our well-tried democratic machinery of elected Parliaments and local authorities is working indifferently. It is subject on one hand to irrational responses to emotional appeals, still more subject to excessive delays in taking action on matters which may be economically or socially important, but possess no 'slogan'. Indeed, it is this impotence of Government which is inducing in so many of our younger men and women a denial of the democratic principle in favour of Fascism or any other autocracy. The Soviet system offers many examples of administration which may prove the salvation of democratic government.

A large section of the first volume is devoted to a consideration of the machinery of production. In the first place we must dismiss the popular idea that in the communist organisation all men are paid alike ; there are differential rates of wage, and piece-work is encouraged. Nor is there a pattern organisation ; besides the trade unions, which control most of the larger industries, there are associations of owner-producers who divide the profits of the enterprise ; and on the land greater variations of management are to be found. The authors give much consideration to the trade unions, which differ from our trade unions in that they include for each establishment the whole of its staff, from the manager and the technicians down to the cooks in the canteen, as well as the doctor and the nurses of the hospital belonging to the works. There is a lively account of the struggle that took place to convert the trade unions from monopolies concerned only with raising wages into organisations aiming at increased efficiency and reduction of costs, into agencies working in fact for the national economy rather than individual profits.

Another important chapter deals with the other end of the chain, the organisation of consumers' co-operatives through which the goods produced get to the public. This is a problem which troubles all communities at the present time ;

price fixing only authorises excessive profits, yet voluntary co-operation languishes.

In their second volume the Webbs proceed to a consideration of the organisation upon which the existence of the U.S.S.R. essentially depends—the planning of the national economy. The idea is simple enough—to provide work for everyone in producing the commodities in universal demand, and to organise the exchange of these commodities so that everyone's demand is satisfied up to the stage that production can attain. Every improvement in output is welcomed as adding to the opportunity of meeting the requirements of the consumer. The possibility of over-production—the bugbear of the capitalist world—is met by a sufficient switching over to production of some other commodity. A community can become rich up to its capacity of all-round production when all are at work and trade is reduced to an exchange of commodities that is not activated or controlled by considerations of the profit to be made. So obvious seems the principle that most people deny the possibility of putting it into practice; on the ground that human capacity is not equal to such a task of organisation. The Webbs explain the vast organisation of Gosplan, the U.S.S.R. State Planning Commission. They set out the objections urged by the orthodox economists, who start with the principle that maximum efficiency is secured in a free market because "prices in the market places are in effect a continual referendum on what men wish to produce, what they wish to consume, where they wish to work and where they wish to invest their savings". To this the Webbs' answer is to ask where in the capitalist world does the free market exist. In the Soviet State, planning *is* working; what other State is free from unemployment or artificial restriction of production? The technique required is no more than that already achieved by such organisations as Imperial Chemical Industries, Ltd., the United States Steel Corporation, and the General Electric Corporation. As to the freedom of choice postulated by the orthodox economist, they observe that "the vast majority of the commodities displayed in the public markets or in the shops of the London streets are as effectively forbidden to two-thirds of all the inhabitants of England as if this large majority were statutorily prohibited from purchasing them". The system does, however, demand a closed community, so nearly self-sufficient that foreign trade is of minor importance.

The greater part of the second volume deals, however, with the social aspects of life in the Soviet Union. There are descriptions of the amazing development of public hygiene, practically unknown in Russia before the Great War, of maternity benefit, sickness, invalidity and old age benefits, and other efforts to ensure economic security for all workers. Other sections deal with education, physical and artistic culture, housing and town planning. Readers of NATURE will be specially interested in the chapter dealing with science and research, for the Soviet Union claims to base all its planning upon science, as the only means of increasing aggregate production which on its system can be distributed, and does not lead to a stoppage of industry through over-production. It is claimed that the scientific men and technicians are obtaining increasing powers of leadership, though since human nature cannot be ousted they are always liable to be 'put in their places' by the administrator or the political 'wire-puller'. Even delation is not unknown. The real point is that the people at large are being brought up to regard science as the guide to life instead of as an uncomfortable and plebeian encroachment on the old order. The Academy of Sciences is described, and also the Communist Academy, which concerns itself with economics and what used to be called social science. No one can doubt but that the Soviet Union has thrown immense energy and almost unlimited resources into the prosecution of research, not only in applied but also in the basic sciences here distinguished as 'pure' science. But the scientific reader will be rather put off by the claims that the Soviet Academy "is unique in its close contact with the manual workers", or the particular account of "the widespread popular participation in scientific research". It is one thing to be interested in the theory of relativity, and another to share in the mathematical reasoning out of which the theory grew. Indeed, there is danger to the research worker in this publicity; it leads to premature publication and the forcing of results.

What perhaps the English reader most wants to know is how far the average man or woman is free to conduct his life in his own way. It appears that he can earn more or less, that he can save and even invest, but his income is limited by a very steeply graduated income tax, and similar death duties prevent the creation of a rentier class. He may acquire private possessions, limited again by the restricted housing he will be allowed; he is not even compelled to work, though as a non-producer he will not obtain a ration card and so must buy as a foreigner does. But he may not leave Russia without permission and he may not accumulate a reserve of funds abroad. There is freedom of marriage and of divorce; for the woman, abortion is legalised but must be carried out in a public hospital by an appointed surgeon; none the less, loose sexual living is being strongly discouraged. Any religion may be practised, but religious propaganda is forbidden; just as there is

freedom of political, philosophic and economic discussion, provided it does not take the form of agitation against the Marxian system or 'grousing' that will lead to slackness of work or sabotage. Unsocial conduct is the crime that may lead to sentence without trial, and for this, as for the delations that take place and the melodramatic trials of experts and managers that have been staged from time to time, the authors can only plead that the Soviet Union has not yet emerged into full security, but has been living in an atmosphere of external hostility that did not scruple to foster treachery within. In general, "freedom is as much the presence of opportunity as the absence of restraint", and in this sense freedom is broadening every year in the Soviet Union.

The Webbs agree that no one in the Soviet State can exercise the liberty of action and the opportunities for personal enjoyment—sport, travel, the æsthetic delights of gardens, fine prints or old wine, that in Britain are open to a rich man or even in a modest way to a professional man. The Soviet Union has set up an ascetic ideal and even the Webbs cannot persuade us that within it there is not lacking much of the colour and variety which to us makes life interesting, but then what an enlargement of living has it not afforded to ninety per cent of its population ?

It must not be taken from this brief summary that the book is a mere compendium of legislation and administration. It is eminently readable (by the way, a future edition should be given an adequate subject index); it is enlivened by argument and illustration, and by criticism of our own conditions based on the Webbs' intimate acquaintance with public administration in this country. It rises to a sober eloquence kindled by the authors' enthusiasm when they see this or that reform, for which their lifelong efforts have been preparing, in process of realisation. It is indeed a work of ultimate significance to the English-speaking world, for it does present a reasoned account of 'the results and aspirations' of the Soviet experiment. Experiment must still be the term for a phase of human society that is not yet twenty years old. But its advent is an event in human history like the spiritual emancipation that came with Christianity and the political emancipation that culminated in the French Revolution. It may be submerged by war, but its ideal of a classless society actuated by other motives than private profit will always be fermenting in the minds of men and women, moving them towards its realisation within all societies. It is for these other societies not to attempt to swallow the Soviet system as a formula, but so to assimilate its lessons and adapt them to their own racial cultures, without having to pass through the cruelties, destruction and waste that marked the Russian Revolution.

A. D. HALL.

# New Conceptions of Disease in Early Childhood

Disease in Childhood :
a Clinical Study. By Dr. Robert S. Frew. The First Year : Birth to One Month, One Month to Six Months, Six Months to One Year. Pp. xv + 669. (London : Macmillan and Co., Ltd., 1936.) 30*s*. net.

IN his preface to this book the author explains that his material is mainly drawn from 8,823 cases seen during seventeen years as physician to the out-patient department of Great Ormond Street Hospital, London. These cases he has arranged in three age groups—namely—those of the *first month of life* ; *those of one month to six months* ; and those of six months to twelve months. This method is thought to offer a better means of studying the special characteristics of disease as it exists during these periods of life. It is clearly implicit in this method that there must be much repetition. The book as a whole has, however, the merit that the author's observations are founded on his own personal experiences, and is not a mere compilation. The majority of medical men who write books, or at any rate first editions, do so at the commencement of their careers, at a time when they have more leisure than experience. Medical books are indeed seldom written at the end of a successful career, when a man has neither the energy nor the incentive to give the world the benefit of his mature experience.

The author of this book has refrained from committing himself to print until he has had experience greater and more valuable than is usually vouchsafed to medical men. Throughout his medical career, Dr. Frew has ploughed a somewhat lonely, albeit contemplative, furrow. He has joined but little in the hurly-burly of medical debate or controversy, and has contributed very little to professional literature. He has not, therefore, been subjected to the fire of criticism which usually beats about the head of the medical publicist, or one who invents theories.

Such criticism, though chastening, has usually a very salutary effect. If before writing his book Dr. Frew had come out into the open and submitted his views, most of which are new and original, to the criticism of his medical colleagues, he would probably have avoided falling into several pitfalls which it is not difficult for the observant reader to detect.

Without wishing to suggest that Dr. Frew is *homo unius libri*, he can scarcely hope to escape the gibe that he is a man obsessed with one or two very imperative ideas which insinuate themselves on almost every page of this book. One of these is that the majority of inborn diseases, the effects of which are manifest during the neo-natal period, are due to a condition which he calls 'hyperphlebæmia', an ugly term which is meant to express a condition in which an excessive quantity of blood is forced into the intra-corporeal venous system during birth, before it is ready to receive it. The expression venous engorgement, congestion, or even stasis, might have satisfied the requirements of more ordinary folk, but perhaps Dr. Frew hopes by the sesquipædalian dimensions of the term to convey an impressiveness which would not attach to a simpler nomenclature. Although 'hyperphlebæmia' offers a very good explanation of many of the hæmorrhagic conditions which are associated with the neo-natal period, it is asking a good deal to expect that it will be accepted as an explanation of such conditions as epilepsy, deaf-mutism, congenital blindness, cretinism, cœliac disease, spasmophilia, and even rickets. Yet Dr. Frew is prepared to extend this particular theory so as to cover these conditions also.

Another of the author's comprehensive theories is that certain congenital abnormalities owing their foundation to conditions which are operative at the beginning of intra-uterine life, such as mongolism, achondroplasia, microcephaly, hare-lip, and congenital heart disease, are due to some abnormality in the yolk supply.

Dr. Frew shows great ingenuity in finding an etiological explanation for many conditions which do not come under either of these categories. For example, his explanation of the causation of congenital anal stenosis, pyloric stenosis, and Hirschsprung's disease, are unlike any of those of which we have previously heard; they may be true all the same.

To our thinking, the least convincing part of this book is that which appears under the heading "Re-adjustments of the Methods of Nutrition". Reading this section we cannot help thinking that the author does not attach great importance to the niceties of "the new knowledge of nutrition". For example, he regards breast milk as a perfect food, which cannot therefore be responsible for errors of nutrition developing in the baby who consumes it. As a matter of fact, breast milk is frequently deficient in several essential elements, and it may contain toxic substances—hence, therefore, it may be the cause of disease. Moreover, it is practically never sterile, which Dr. Frew considers to be one of its virtues.

There can, however, be no doubt that this is one of the most original and arresting of medical publications that have appeared within recent years on the subject of the diseases of infants, and it will certainly arouse great interest in medical circles, even though it gives rise to much criticism.

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# Colloidal Science in Agriculture

**Colloids in Agriculture**
By Dr. C. E. Marshall. Pp. viii+184. (London: Edward Arnold and Co., 1935.) 5*s*. net.

IS a man a better farmer for understanding the meaning of the word colloid? Dr. Marshall evidently thinks so, since he has written his book for agricultural students, rural instructors, district lecturers and county organisers. His plan is first to outline the classical investigations of colloid science and then to apply some of the principles which emerge to agricultural subjects. All this is admirable so long as it is agreed that instruction of this kind is wanted. But is it?

To express a doubt is not to deny the value of general knowledge of things scientific in broadening the mind. This is quite another matter, since such learning need have no connexion with everyday needs. Presumably the author considers that his book will help farmers to farm, but it is difficult to see how. The pure science background needed for an understanding of the book is considerable. If this background is vague, the reader's understanding of colloids will be vaguer still. What use can this be to a farmer in tackling his practical problems? Even if he were really to assimilate the interesting section on insecticidal and fungicidal sprays, he is told at the end that he is largely in the hands of the manufacturers, and that the chemist can add but little to his own experience

and the advice of others. The reader gets little more assurance from the chapter on milk products. He is told that the colloid chemistry of butter-making affords one of the most striking examples of a highly developed technical process the fundamental principles of which are still not understood, and that much less is known of the colloid chemistry of cheese-making.

In his discussion of soil, the author misses his best chance of showing that its colloidal nature is of great importance to the farmer through the phenomenon of base exchange. True, this property is still under investigation; but there is much definite information which could have been put in a practical form that would have shown the magnitude of the base-holding power of various classes of soil in relation to the nutrient requirements of crops. The three references to base exchange are too academic and also too scrappy to be of service to practical agriculturists.

The investigation of the soil from the colloidal point of view is of recent development, and it is no discredit to those concerned that much of the field is still *sub judice*. Until the position has been clarified by further research, and indeed until a more straightforward definition of the word 'colloid' can be given, it seems better to refrain from forcing the subject into prominence in the curriculum of a course in agriculture. The teaching methods which Dr. Marshall condemns as haphazard may be better than he thinks.

R. KENWORTHY SCHOFIELD.

# Electricity in Metals

**Elektronenleitung:**
Galvanomagnetische, Thermoelektrische und Verwandte Effekte. Von Prof. W. Meissner. Unter Mitwirkung von Dr. M. Kohler und Dr. H. Reddemann. (Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Band 11, Teil 2.) Pp. xii+547. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 44 gold marks.

SO much has recently been written on the theoretical aspects of the conduction of electricity by metals, of the problems of supra-conductivity, of the poor conductor and of galvanomagnetic effects that it is very satisfactory to have available this excellent book on the experimental side. For it marshals the experimental facts in a handy manner, and deals with the proof of fundamental laws like that of Ohm and with the more recent characteristic temperature relations such as that of Grüneisen, and illustrates them with a wealth of experimental data which can only be found with difficulty elsewhere. The technique and results of modern work on resistance of metals under pressure and on the influence of magnetic fields upon resistance are well described. The survey of the electrical behaviour of alloys is adequate and special attention is paid to the resistance of powders. The determination of the Wiedemann-Franz ratio is fully discussed and the data well considered. Supra-conductivity, naturally, receives very full treatment from W. Meissner, and many readers will find the section of the book which deals with it particularly valuable. Some discussion of photo-electric effects is given, but as these were fully treated in vol. 23 (Part 2), only special features are dealt with here. The first part of the book closes with an interesting outline of modern theories of electrical conduction.

The second part of the volume deals with galvanomagnetic and thermomagnetic effects and forms an important source of information; for the descriptions of experimental measurements of the twelve separate effects into which galvanomagnetic phenomena may be divided are to be found scattered throughout a wide range of original papers, and little seems to have been done to classify these experiments or to compare them at all critically. It can be said, too, that the treatment of thermo-electric phenomena is unusually clear and good, particular emphasis being placed on the properties of single crystals.

Some fifty-four pages of references are given, and it is here that an improvement could easily have been made. Presumably, the subject matter of each reference is discussed somewhere in this book, and it would have been very helpful if the number of the page on which it is treated had been added. On perusing these many hundreds of references, one cannot help being struck by the small number of the references to papers published by the Royal Society and the Physical Society, and one wonders whether atomic physics has virtually excluded the matters dealt with in this book from these publications, or whether the latter tend to be overlooked in Germany. The printing and illustration of the volume are, of course, of high standard, and it can be thoroughly recommended to all interested in these branches of physics.

L. F. B.

**Vergleichende Länderkunde**
Von Alfred Hettner. Band 3: Die Gewässer des Festlandes; Die Klimate der Erde. Pp. viii+202. 7.40 gold marks. Band 4: Die Pflanzenwelt; Die Tierwelt; Die Menschheit; Die Erdräume. Pp. x+347. 13 gold marks. (Leipzig und Berlin: B. G. Teubner, 1934–1935.)

THE two concluding volumes of Prof. Hettner's treatise on physical geography adhere to the principles laid down in vol. 1 and, while he deals with the continental areas in particular, he includes also the oceanic islands but excludes the oceans themselves. In some respects it is to be regretted that this omission has been considered desirable, for the complete work is one of considerable value, and its usefulness would have been enhanced by the inclusion of a section on oceanography.

Vol. 3 is divided into two sections, the first devoted to a discussion of the hydrosphere, in a limited sense and excluding the oceans. Under this head the author deals with snow and ice, springs, rivers and lakes. The second section consists of an excellent and comprehensive treatment of climatology, concluding with a regional discussion of the subject.

The final volume, in which the author deals with the geography of plants and animals together with a brief discussion of human geography, is probably the most interesting part of the entire work. It is to the final section in particular that the title of Prof. Hettner's book most aptly applies, and it is to be regretted that this section could not have been considerably expanded.

As a whole, the four volumes provide an exceedingly useful text-book, which should appeal to more advanced students of geography, and which covers approximately the same ground as de Martonne's "Traité de Géographie Physique".

**Primitives and the Supernatural**
By Lucien Lévy-Bruhl. Authorized translation by Lilian A. Clare. Pp. 405. (London: George Allen and Unwin, Ltd., 1936.) 18*s*. net.

M. LÉVY-BRUHL here adds to his previous studies of the primitive mind an examination of its reactions when confronted with the supernatural. As is well known, in his conception, the working of the primitive mind is so far removed from the logic of developed reasoning as to warrant regarding its processes as belonging to a different order. It has no conception of the world of abstract thought, of causation, of categories and the like. Its cosmos is unpredictable and unstable; it is a realm under the control of spirits, both good and evil, who are to be propitiated and if possible controlled. In these conditions it seems difficult to draw the line between normal and supernormal, natural and supernatural. M. Lévy-Bruhl, whose knowledge of the literature of the subject is stupendous, here passes in review the ceremonies and rites, and the beliefs and customs relating to omens, amulets, ancestor worship, purification and the like, whereby primitive man has endeavoured to secure that the course of events either shall turn to his advantage or at least not be to his detriment.

**Tabulæ Biologicæ Periodicæ**
Herausgegeben von C. Oppenheimer und L. Pincussen. Band 4, Nr. 4 (= Tabulæ Biologicæ, Band 10, Nr. 4). Pp. 289–388. Complete vol., 55 gold marks. Band 5, Nr. 1 (= Tabulæ Biologicæ, Band 11, Nr. 1). Pp. 144. Band 5, Nr. 2 (= Tabulæ Biologicæ, Band 11, Nr. 2). Pp. 145–224. Complete vol., 55 gold marks. (Den Haag: W. Junk, 1935.)

THE data given in these parts of Tabulæ Biologicæ Periodicæ are arranged as in the previous volumes. The fourth part of vol. 4 contains the concluding part of an article by Th. A. Maass on the biology and toxicology of chemical substances used in war; it also contains the index to the volume. K. Boresch contributes articles on the mineral content of plants, the first in vol. 4 and the second in vol. 5 (No. 1 and 2). The most important contribution to vol. 5 is a long article on allergy (or sensitiveness to proteins foreign to the body) by Th. A. Maass, whilst O. Reitz summarises our knowledge of heavy water.

**Practical Biology for Medical Students**
By C. J. Wallis. Pp. xii+247. (London: William Heinemann (Medical Books), Ltd., 1936.) 12*s*. 6*d*. net.

THIS laboratory manual gives detailed practical instructions to students of biology for first medical examinations and also supplies additional matter in order that it may satisfy the Higher School Certificate examinations in the subject. An unusual but useful feature in such a book is a separate section on elementary biochemistry.

Those diagrams which are not borrowed from other sources tend to be rather crude, and in places, if not misleading, then of little practical value to the student.

The book should prove useful to the teacher of biology. Since a theoretical text-book would be necessary for a student taking a course such as is provided by this book, its high price is unfortunate.

**The Identity Theory**
By Blamey Stevens. Second edition, revised and amplified. Pp. xvi+252. (Manchester: Sherratt and Hughes, 1936.) 12*s*. 6*d*.

THE object of this book is to build up a complete system of mathematical physics on a basis that is very different from that currently accepted. The fundamental assumptions are that inertia, time and space are each complete measurements of the same thing, and that by expressing this identity we get the laws of physics. For example, the space-time identity leads at once to the result that the observed velocity of light is independent of the motion of the observer, the fundamental postulate of relativity. Other identities lead to Maxwell's electromagnetic equations, Newton's laws of motion and a theory of relativity. The later chapters deal with radiation and the quantum theory. Whatever may be thought of the author's conclusions, he shows considerable knowledge of physics and mathematics.

# Holiday Sunshine in the British Isles*

IN the absence of any long-range forecasts, made along strictly scientific lines, as to the occurrence of sunny periods during the year, the accumulated statistics of past sunshine records warrant a special study. They serve as a guide to the average conditions for any season. Although few are fortunate enough to select the time for their holidays, all have some choice in the matter of locality. Sunshine, in these days especially, may be regarded as the most important meteorological requirement for an enjoyable holiday.

The data are described as referring to bright sunshine because a certain intensity is required before the recorder will register. The standard instrument of the meteorologist for recording sunshine is of the Campbell-Stokes pattern, in which the duration of sunshine is recorded in the form of a scorched or burnt line, traced on a graduated card by means of a spherical lens acting as a burning glass. The instrument was first introduced by Mr. J. F. Campbell in 1853 at the Office of the Board of Health in Whitehall, and afterwards modified by Sir George Stokes to receive a strip of cardboard on which to record the focused rays of the sun. Records from these instruments were first published in 1880, and the number of climatological stations reporting to the Meteorological Office has steadily increased, so that in 1934 it was possible to publish averages of bright sunshine for 171 stations in the British Isles for periods ending 1930, usually 1901–30. Naturally, the stations are more numerous in the south of England and fewest in the relatively uninhabited mountainous regions. In many districts the distribution has had to be inferred from records outside these areas. This renders all the more important the record maintained at Ben Nevis Observatory, at an altitude of 4,400 ft., during the years 1891–1902 for which the mean values in hours were: J. 0·64; F. 1·61; M. 2·06; A. 2·88; M. 4·27; J. 4·14; J. 2·95; A. 2·00; S. 1·91; O. 1·58; N. 1·02; D. 0·55; Year 2·13. Actually this station is probably the least sunny in the whole of western Europe. The frequency of cloud is confirmed by the fact that those climbing to the summit are but infrequently rewarded by a good view.

It is well known that the average amount of sunshine tends to decrease from south to north and from the coast inland. Before considering the distribution of bright sunshine over the country generally, and from month to month, it seems desirable to define the total possible duration. The duration of possible sunshine is referred to as the interval between the ascending and descending transits of the centre of the sun's disk across the horizon, as actually seen. The mean daily duration of possible sunshine is set out in Table 1 for each month of the year for latitudes 50°, 52°, 54°, 56°, 58° and 60° N. Latitude 50° corresponds roughly with the Lizard; 52° with Valentia, Cork, Fishguard, Hereford, Buckingham and Felixstowe; 54° with Blacksod Point, Greenore, Morecambe and York; 56° with Helensburgh and Leith; 58° with the south of Lewis and Lairg; and 60° with the south of the Shetland Islands. The statistics show that at mid-summer the possible duration of sunshine in the north of Scotland is about two hours greater, and at mid-winter nearly two hours less than that in the south of England. On the other hand, there is very little difference with latitude for both March and September.

Table 1.—Daily mean duration of possible sunshine.

| Month | Latitude (North) | | | | | |
|---|---|---|---|---|---|---|
| | 50° | 52° | 54° | 56° | 58° | 60° |
| | hr. | hr. | hr. | hr. | hr. | hr. |
| January ... | 8·6 | 8·3 | 7·9 | 7·6 | 7·2 | 6·7 |
| February ... | 10·0 | 9·9 | 9·7 | 9·5 | 9·3 | 9·0 |
| March ... | 11·8 | 11·8 | 11·8 | 11·7 | 11·7 | 11·7 |
| April ... | 13·7 | 13·8 | 14·0 | 14·1 | 14·3 | 14·5 |
| May ... | 15·3 | 15·6 | 15·9 | 16·2 | 16·6 | 17·0 |
| June ... | 16·2 | 16·6 | 17·0 | 17·4 | 17·9 | 18·6 |
| July ... | 15·8 | 16·1 | 16·5 | 16·9 | 17·3 | 17·9 |
| August ... | 14·4 | 14·6 | 14·8 | 15·0 | 15·3 | 15·6 |
| September ... | 12·6 | 12·6 | 12·7 | 12·7 | 12·8 | 12·9 |
| October ... | 10·7 | 10·6 | 10·5 | 10·4 | 10·3 | 10·1 |
| November ... | 9·0 | 8·8 | 8·5 | 8·2 | 7·9 | 7·5 |
| December ... | 8·1 | 7·8 | 7·4 | 7·0 | 6·5 | 5·9 |
| Year ... | 12·20 | 12·22 | 12·23 | 12·25 | 12·27 | 12·30 |

The most convenient procedure, in the case of the British Isles, is to consider each average value of bright sunshine as a percentage of the possible duration. So far as the annual values are concerned the largest percentages (40 per cent or more) occur along parts of the south and south-east coasts of England, including the neighbourhood of Torquay, from Weymouth to Dungeness, most of the Isle of Wight as well as near Margate and Felixstowe. Stations in Jersey and Guernsey report 42 per cent, and as much as 41 per cent occurs at Bognor Regis, Eastbourne, Worthing and Sandown. The area with more than 35 per cent extends along the west coast to include parts of the Isle of Man and Anglesey and the neighbourhood of Llandudno, and along the east coast almost to the Humber. Less than 30 per cent occurs over a large area stretching northwards from central Wales and the Midlands to include

* The information in this article is based on a paper on "The distribution over the British Isles of the average duration of bright sunshine: monthly and annual maps and statistics", by Dr. J. Glasspoole and D. S. Hancock, published in the *Journal of the Royal Meteorological Society* for April 1936.

most of Scotland, apart from coastal districts south of the Isle of Skye on the west and Aberdeen on the east. The island of Tiree gives the surprisingly high value of 35 per cent and Lossiemouth, on the Moray Firth, as much as 30 per cent. Over the mountainous districts of central and northern Scotland bright sunshine occurs on only 20–25 per cent of the possible duration. Over Ireland the range is small, being from 35 per cent in the extreme south-west to 28 per cent in the north-west. The smallest values in England, of just less than 25 per cent, occur in certain industrial areas of the Midlands. In the suburbs of London bright sunshine occurs on about one-third of the total possible time and this proportion is experienced in coastal districts as far north as Morecambe, parts of the Isle of Man and Spurn Head, and also in certain of the flatter islands to the south-west of Scotland, such as Tiree.

The distribution over the country for each month is similar to that shown on the annual map so far as the localities of much or little sunshine is concerned. The actual values increase steadily, however, from December until April, May or June. The minimum percentage occurs at most stations in December, although a few give similar percentages in December and January, such as Armagh in Northern Ireland, Torquay and Durham. There is less than 10 per cent in the neighbourhood of the manufacturing towns near Manchester, and in the mountainous districts of the north-west of Scotland in both January and December. On the other hand, percentages of 45 per cent and more occur in six months. Such percentages occur as early as April along the coasts of Cornwall and south Devon and at isolated coastal stations in the south-east, and in May, June, July, August and September along most of the south and south-east coasts from Torquay to Lowestoft. Percentages of 45 or more also occur in April and May in Tiree. They cover the largest part of the British Isles in May. In June these values also occur in the neighbourhood of the Severn Estuary. In May the average amounts of bright sunshine reach half the possible duration, when they are confined to a few coastal stations in the extreme south-east of England from Eastbourne to Felixstowe.

The sunniest month of the year is either April, May or June over practically the whole of the British Isles. *April* is the sunniest month in the Outer Hebrides, in the neighbourhood of Loch Ness, near Aberdeen, and the extreme south of Cornwall. *May* is the sunniest month from Mull to northern Aberdeenshire, in the south-west of Scotland, in the south-west of Ireland, near Aberystwyth and over most of the south-eastern half of England. *June* is the sunniest month over central and south-eastern Scotland, the south-east of Ireland, and most of the north-western half of England and Wales. *July* nowhere gives the largest percentage values for the year (although in the neighbourhood of London July ranks as the sunniest month in actual hours). *August* is the sunniest month only at Lowestoft and in Jersey and Guernsey, but it ranks with May at Greenwich. Most stations show a fairly simple increase in the percentage values from December to the early summer months, but there is a subsidiary maximum in August in parts of the south-east of England and the Midlands, and a subsidiary maximum in September over most of Scotland, the north-west of England and Ireland. At Newquay there is little difference in the percentage sunshine for April, May and June, and at Torquay between May, June and July.

Table 2.—Average General Sunshine, 1901–30, as percentages of possible.

| | England and Wales Per cent | Scotland Per cent | Ireland Per cent | British Isles Per cent |
|---|---|---|---|---|
| January ... ... | 18·8 | 14·0 | 18·2 | 17·3 |
| February ... ... | 24·0 | 23·6 | 23·6 | 23·8 |
| March ... ... | 30·3 | 28·5 | 30·9 | 30·1 |
| April ... ... ... | 35·0 | 34·8 | 37·7 | 35·6 |
| May ... ... .. | 40·0 | 34·4 | 36·2 | 37·0 |
| June ... ... ... | 40·2 | 33·9 | 35·2 | 37·2 |
| July ... ... .. | 36·9 | 28·3 | 31·6 | 33·3 |
| August ... ... | 37·0 | 27·7 | 31·3 | 33·1 |
| September ... ... | 37·4 | 29·4 | 32·2 | 33·8 |
| October ... ... | 30·4 | 25·8 | 27·5 | 28·5 |
| November ... ... | 23·7 | 20·1 | 23·8 | 22·9 |
| December ... ... | 16·7 | 13·0 | 17·0 | 15·8 |
| Spring (March–May) .. | 35·1 | 32·6 | 34·0 | 34·4 |
| Summer (June–Aug.) ... | 38·0 | 30·0 | 32·7 | 34·5 |
| Autumn (Sept.–Nov.) | 30·5 | 25·1 | 27·9 | 28·4 |
| Winter (Dec.–Feb.) ... | 19·7 | 17·0 | 19·6 | 19·0 |
| Year ... ... ... | 30·8 | 26·2 | 28·8 | 29·2 |

The average general values for the months and the seasons are given in Table 2 for England and Wales, Scotland, Ireland and the British Isles as a whole. The table emphasises the large values for the bright sunshine in both Scotland and Ireland in April and the appreciably greater sunshine of May than of either July or August over England and Wales.

So far as the total amounts of bright sunshine are concerned, there are therefore obvious advantages in early holidays. Along the east and south coasts, from Scarborough to the Isle of Wight, May has advantages, while along the west and south-west coasts of England June is to be preferred. For holidays in April the records suggest the neighbourhood of Penzance and the Scilly Isles, and in August the Channel Isles. In the English Lake District the choice would fall to May, June or September, before July or August. For a visit to the islands of the south-west of Scotland there are advantages in selecting April or May.

On the average, the sunniest month of the year occurs six months after the least sunny month over a broad strip across central districts of Great Britain. Both to the north-west and south-east

the sunniest month occurs earlier. There is a marked tendency therefore in many localities for the summer to come upon us relatively quickly and for winter to be longer delayed.

It must be admitted that sunshine is only one meteorological factor to be considered in the selection of the best time and locality for holidays. Attention must also be paid to the frequency of rainfall, air temperature and sea temperature. For this reason the procedure adopted in the Handbook of the British Health Resorts Association is a particularly happy one, for it gives the meteorological statistics of each health resort, together with comments on the climate from a medical aspect. It is a comforting fact, however, that in all parts of the British Isles the average annual duration of sunshine exceeds that of recordable rainfall, and that in the south-east of England the duration of sunshine is as much as seven times greater than that of recordable rain.

## Percy Sladen Expedition to Lake Huleh

By Roger Washbourn and R. F. Jones

THE Percy Sladen Expedition to Lake Huleh, Palestine, consisting of the present writers, has now returned. Biological investigations have been carried out during the greater part of the period August–December 1935. While much work remains to be done in the sorting and identification of the material, it is nevertheless felt that a preliminary account of the work may be of interest.

As stated in NATURE of October 5, 1935, p. 538, the region called the Huleh comprises two parts, which differ considerably (Fig. 1). The lake is at the southern end of the broad Huleh valley, and is separated from Tiberias by a low range of hills. It is bounded on the northern side by the swamp, which is for the most part an impenetrable tangle of papyrus, but which also contains channels of running water, and pools which may be up to an acre or so in extent. The lake covers approximately 5 square miles, and is of a general depth of 4–6 ft., with occasional deeper holes.

The lake shore is of gravel, where winter-running wadis have brought down much material from the surrounding hills, and where the direction of wave action keeps the stones clear from mud. In quiet places, under the shelter of the gravel spits, the shore is of mud, which in places becomes colonised by *Phragmites*. The bottom of the lake is everywhere of a light greyish mud. This mud is colonised by a great mass of aquatic plants, the stems of which may reach the surface of the water. The chief types present are species of *Myriophyllum*, *Potomogeton*, and *Nuphar*. They occur in large consociations, some of which are practically pure communities of a single species.

The water of the lake is fresh to the taste (accurate analyses of the chemical composition are being made), and the temperature is usually high. Fluctuations in temperature must be considerable; on one occasion the thermometer was observed to rise from 29° to 31·4° C. in approximately $2\frac{1}{4}$ hours. The water is alkaline; the $p$H being approximately 7·8–8·0 during the daytime. The oxygen content was found to be high, and the carbon dioxide content comparatively low.

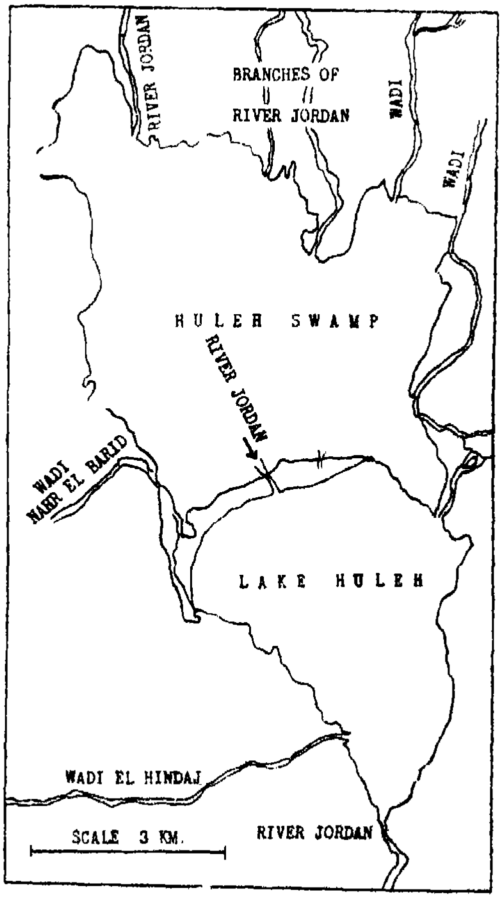


FIG. 1.

The phytoplankton was exceedingly dense, and was probably responsible largely for the constant colour of the lake water. The animal plankton on the other hand was meagre, and by no means

corresponded with Barrois's[1] estimation that it was "an abundant plankton". Quantitative hauls were not attempted owing to the difficulty of hauling in such a small depth of water, and where there is so much rooted plant growth. Systematic hauls were made every month, and are being continued throughout the year, through the kindness of the Jewish Colony at Yesud Hamalla.

The fauna consists of free-swimming, mud-living lithophilous and phytophilous types. Our collections of fish have yet to be investigated, but it does not appear that the fish fauna differs markedly from that of Lake Tiberias. Cichlid fishes are very common, and provide most of the fish for the small fishing community; cyprinids also occur, as does the siluroid *Clarias*. It seems, however, that the actual number of different species is not so high as in Lake Tiberias. In the mud-living community, the striking feature was the amazing abundance of the gastropod *Melanopsis*; one haul of the Petersen grab bringing up a hundred or more individuals.

Considering that a mother-of-pearl industry used to be carried on, and that Hornell[2] describes the unionid lamellibranchs as very common, the numbers actually found were low. *Corbicula*, a common mollusc in Tiberias, is not common in Huleh. Other common animals living in the mud of the lake bottom were many small oligochætes and chironomid larvæ. The stone-living fauna comprises one species of polyzoan, probably *Fredricella*, ephemerid nymphs of the genus *Cœnis*, a species of leech. *Melanopsis* and *Melania* are also very numerous.

Along the northern end of the lake there is a broad mud bank which runs also some way down the western side. This is colonised by a very dense zone of *Nuphar*, mixed with *Ceratophyllum*. To the west this is succeeded on the landward side by *Phragmites*, to the north it may be succeeded by *Papyrus* or *Phragmites*.

In this region, the fauna differs markedly from that of the lake; typical lake forms are replaced by others which occur in the swamp. The lake gastropods occur in numbers in the *Nuphar* zone, where together with various insect larvæ they are the commonest animals. The *Nuphar* zone itself supports a fauna: a coleopteron, several diptera and a lepidopteron. In the *Phragmites* the *Melania* and *Melanopsis* cease to occur, and one finds various species of smaller gastropods, such as also occur in the swamps. *Cœnis* is absent, and the whole character changes completely.

FIG. 2. Lake Huleh from western shore. Photograph by R. Washbourn.

The swamp proper sharply limits the northward extension of the lake. It is approximately three miles broad, and extends northward for another five miles before ending more or less abruptly in reclaimed land, the latter being tilled and used for millet growing.

The most common consociation of the swamp is dominated by *Cyperus papyrus*. This community covers many square miles, and may be found under conditions varying from complete submergence of the rhizomes in water, to cases in which these organs are growing more or less superficially in damp peat. In the submerged state, the thick rhizomes are usually so intermingled as to form a more or less floating raft, usually firm enough to bear the weight of a man, but often not rigid enough to prevent the whole mass sinking for several yards around as one walks on it. The rhizomes lie from a half to one foot below the surface of the water, with the roots growing vertically downwards to the floor of the swamp through a mass of old and decaying papyrus debris. It is difficult to trace these roots in dense papyrus; but in the channels which are kept clear by the Arabs, rhizomes attempting to grow across may be found bearing roots up to four feet in length.

The mass of dead papyrus is continually increasing; but the decomposition is slow, and this, together with the tremendous additional weight of the living papyrus, gradually consolidates the mass into a loose peat which in time raises the level of the floor of the swamp. There are thus formed large areas of papyrus growing on the surface of the damp peat, with the water-level some three or more feet below. This condition obtains during the dry season (June–November), but the heavy rains in January and February cause a rise in the water-level, so that the papyrus is once

more in the submerged condition. The papyrus can grow to a height of fifteen feet, and in spite of the fact that, where it is most dense, it intercepts much of the direct light, enough light passes through to allow the development of a sub-flora. The taller plants, such as *Lythrum salicaria* and *Lycopus europæus*, may reach much of the direct light; but in the lower vegetation stratum there is little else beside a species of fern which grows in great profusion.

The open water system of the swamp is made up of the running water of the channels, the pools and the River Jordan. Fringing the channels there may be *Ceratophyllum* with *Utricularia* and algæ floating among its crowded upper branches. Continual disturbance of the water and the bottom by Arabs prevents to a great extent the growth of the small plants of *Ceratophyllum* in these channels; but once they have fallen into disuse a dense mass of *Ceratophyllum* soon grows up and blocks them.

FIG. 3. A clearing in the papyrus swamp, Lake Huleh. Photograph by R. Washbourn.

The pools may be bordered either by *Phragmites* or by papyrus; they are often covered with *Nuphar* and *Ceratophyllum*; while in many pools *Nymphæa* is common. It is interesting that *Nymphæa* is confined to the swamp and that it was never found in the lake.

Along the stretch of the Jordan which passes through the swamp the banks are slightly raised and are generally covered with papyrus. Along the edge of this papyrus in very deep water there may be a fringing zone of *Polygonum* spp.; *Cladium mariscus* is often to be found near the river bank. On the bank there may be various grasses; *Cyperus* spp. (differing from papyrus), and *Typha* spp. Towards the swamp these are usually succeeded by *Phragmites* or papyrus.

The composition of the water of the swamp differs markedly from that of the lake. The oxygen content, as might be expected, was very low (1–2 c.c. per litre). The *p*H was always neutral or slightly alkaline (about *p*H 7·0) and with an alkali reserve of 0·004 *N*, gives a high carbon dioxide content. The temperatures were all comparatively low, and did not fluctuate very greatly. This suggests that the water may be derived from springs in the swamp itself. Furthermore, on analysis, the water samples from various portions of wet swamp were found to show roughly the same characteristics as that of the channels. It may be that the presence of water in certain parts of the swamp in summer is due to the proximity of channels or springs.

The fauna of the channels may depend in great measure upon the growth of a fringing zone of *Ceratophyllum*. The fauna was meagre; a few Entomostraca, Hemiptera and cyprinodont fishes occurring, with *Anopheles* larvæ in the quieter bays. In the wetter parts of the swamp gastropod molluscs were numerous, a number of different species being present, including one species very similar to *Ancylus*. A prawn, the crab *Potamos* and the turtle *Clemmys* were common.

It is not within the scope of this article to describe the fauna of the drier part of the swamp, for it takes on a much more terrestrial facies: spiders, Lepidoptera, Orthoptera, etc., making their way in from the surrounding country. Mention may, however, be made of the numerous earthworms, which must have a very considerable modifying influence on the peat soil.

It is believed that the comparatively poor fauna of the swamp is due to the great fluctuations in the water-level and to the high carbon dioxide content and low oxygen content of the water. All these factors have been shown to be physiologically of great importance to the majority of animals.

The scope of the expedition was limited by the number of the personnel; and certain groups were perforce omitted from the collections. The objects of the work were to investigate the flora and fauna for forms of Ethiopian origin, to study in particular the plant ecology of a papyrus swamp, and to describe the distribution of such animals as were found. We hope that the material collected may throw fresh light on the problem of the origin of the Jordan Valley fauna.

Our thanks are due to the Hebrew University of Jerusalem for the valuable help they gave us, in particular to Dr. G. Mer, of the Malaria Research Station, Rosh Pinna.

[1] T. Barrois, "Contributions à l'étude de quelques lacs en Syrie", *Rev. Biol. du Nord France*, vol. 6.
[2] J. Hornell, "Report on the Fisheries of Palestine".

# Mellon Institute of Industrial Research

DR. E. R. WEIDLEIN, the director of the Mellon Institute for Industrial Research, Pittsburgh, has published his twenty-third Report to the trustees. The Institute, established in 1913, was the material outcome of Prof. Robert Kennedy Duncan's system of industrial fellowships started in the University of Pittsburgh two years before. Since 1911, there have been 1,085 industrial fellowships on 268 technological subjects, and more than 500 new or improved processes and products have resulted, recorded in nearly 2,000 contributions to scientific literature. The Report claims with truth that the 363 fellows and 414 assistants who, having completed their fellowships, have entered the fields of manufacture, commerce and education constitute a most valuable gift. To celebrate the silver jubilee, a new building is under construction.

In the year ended March 1, 1936, the total sum of 632,546 dollars was received by the Institute from companies and associations for the creation of fellowships to defray the cost of scientific investigations; and the total contribution during the full period of twenty-five years is 10,662,091 dollars.

The Report for 1935–36 under review records the production in the laboratories during the year of an opal glass, two marble products, a group of refractories, several series of organic compounds, a synthetic resin, a specialty paper, an alloy steel for safety-razor blades, and several waterproofing agents for open fabrics. Physical methods for determining the character and amount of suspended solids in the air are progressing, the spectrograph and X-rays having been used to study ashed specimens of lungs. The Department of Research in Pure Chemistry, in co-operation with local hospitals, has investigated cinchona alkaloids, especially in relation to pneumonia. Some of these products cause serious visual trouble. Hydroxyethylapocupreine has given encouraging results. Patents have been obtained for some of these products "to ensure proper production and distribution". There is hope as the result of another research of producing anti-pneumococcic and anti-streptococcic sera.

During the calendar year 1935, 10 bulletins, 22 research reports and 58 other papers were issued from the Institute; 34 U.S. patents and 78 foreign patents were obtained. The record for the twenty-five years is 18 books, 132 bulletins, 726 research reports, 1,081 articles, and 617 U.S. patents. These statistics afford eloquent and incontrovertible evidence of the success of the scheme of industrial fellowships and reflect great credit on its organisers.

The present writer having had the privilege of attending the birth of the Mellon Institute derives special pleasure in expressing the congratulations of NATURE on the completion of twenty-five years working of the industrial fellowship system in the University of Pittsburgh. The idea came to life so long ago as 1906, when Duncan was attending the International Congress of Applied Chemistry in Rome; a year later, he established the first industrial fellowship in the University of Kansas, and in May 1907 published particulars of the scheme in the *North American Review*. The work, as already stated, commenced in Pittsburgh in 1911, and two years afterwards the brothers Andrew Richard and Richard Beatty Mellon, by a gift of half a million dollars, placed it on a permanent basis.

I first heard of the scheme when visiting the Canadian universities in 1910, as a preliminary to the first Congress of the Universities of the Empire, held in London in 1912. Discussing with Prof. H. R. Lang of the University of Toronto the urgent need for establishing *liaison* between the universities and industry if Great Britain were to survive the coming war, whether economic or martial, I was informed of Duncan's scheme and that Duncan, himself a patriotic Canadian, had offered to establish his scheme in that University. He met with refusal, and Pittsburgh secured what Toronto could not accept. In 1913, as Mitchell Student of the University of London, I investigated the work under Duncan's tutelage both in the University of Kansas and the University of Pittsburgh; and published the results in a Board of Education Pamphlet (No. 30; August 1915), and in an article in the *Quarterly Review* (October 1915). NATURE and other scientific and lay journals gave publicity to the scheme; but, possibly owing to preoccupations of the Great War, not much interest was displayed by universities or industries.

In 1915, the Government, recognising the urgency of the problem, published a "Scheme for the Organization and Development of Scientific and Industrial Research" which opened with the encouraging statement: "There is a strong consensus of opinion among persons engaged both in science and in industry that a special need exists at the present time for new machinery and for additional State assistance in order to promote and organise scientific research with a

view especially to its application to trade and industry".

It was declared in the scheme that "a great part of all research will necessarily be done in Universities and Colleges". In the first report of the Committee of the Privy Council (for 1915–16), signed by the chairman, Sir William McCormick, there was a full and admirable discussion of the problem referred to the Committee, which examined with restrained enthusiasm the possibility of establishing special research institutes in universities. The time, in any event, would have been unpropitious for the adoption of the policy of promoting industrial research in universities and colleges. Since the Great War, however, conditions have changed. There has been a prodigious increase in the number of university graduates capable of undertaking scientific and industrial research; a great development of industries based on science, assisted, without question, by the limitation of German and other foreign competition; and a quickened sense that science in alliance with industry must help to solve the problem of unemployment. These conditions are favourable for an experiment on the basis admirably demonstrated by the Mellon Institute of Industrial Research.

T. LL. HUMBERSTONE.

# Obituary

## Prof. Karl Pearson, F.R.S.

WITH Prof. Karl Pearson, who died suddenly on April 27, has passed one of the great figures of the last half-century in science. He was born in 1857, son of William Pearson, K.C., of sturdy Yorkshire stock. Educated first at University College School, he entered King's College, Cambridge, as a scholar in 1875, and took his B.A. (Mathematical Tripos, 3rd Wrangler) in 1879; he was elected a fellow of the college in the following year, and remained a fellow until 1886. In 1882 he was called to the Bar in the Inner Temple, and originally intended to make the law his profession. But Sir Alexander Kennedy persuaded him to give up law and, to use his own expression, "finally landed me in Clifford's chair of Applied Mathematics at University College"—the Goldsmid professorship of applied mathematics and mechanics in the University of London. This was in 1884. He was the spiritual, not the direct, successor to Clifford, who had died in 1879; the post had in the meantime been held by Prof. Henrici.

In this chair Pearson lectured not only in the varied subjects required by candidates for University of London degrees in arts and science, but also gave lectures to engineering students, with accompanying classes in the drawing office, on graphic methods applied to mechanics, the determination of stresses in structures and so forth. There was, I believe, no similar course held in any British engineering school at that time, except possibly by Prof. Henrici at the then Central Technical College. During these early years, Pearson completed and edited, at the request of the syndics of the Cambridge University Press, Todhunter's "History of the Theory of Elasticity" (1886–93), the request having apparently been made to him, as he stated in some recent recollections (*Math. Gazette*, Feb. 1936), owing to Todhunter having incorporated in his MSS. a portion of one of Pearson's papers for a Smith Prize.

Pearson had been keenly interested by the work of Francis Galton and his statistical ideas, and felt that here was a new field for mathematical treatment and advance. Measurements on crabs made by his colleague Prof. Weldon presented an initial problem, and his first statistical paper was communicated to the Royal Society in October 1893 under the title "Contributions to the Mathematical Theory of Evolution", words used afterwards in the altered form "Mathematical Contributions to the Theory of Evolution" as a general title to many other memoirs. This paper dealt with the problem of dissecting a frequency distribution which could be assumed to be compounded of two normal frequency curves, and is important not only for its special subject but also for the introduction of the method of moments. This was followed in December 1894 by the second memoir, "Skew Variation in Homogeneous Material", developing his now well-known system of frequency curves, and by the third in September 1895 on "Regression, Heredity and Panmixia", developing the theory of correlation with special reference to heredity.

The memoir by Pearson and Miss Alice Lee (June 1897) "On the Distribution of Frequency of Barometric Height, etc." forms an interlude on a practical application; but with the fourth of the "Evolution" series (October 1897) "On the Probable Errors of Frequency Constants", written in conjunction with L. N. G. Filon, then his demonstrator but afterwards his successor in the chair, the first stage in the development of the Pearsonian *corpus* of statistical theory may be said to have been completed—frequency distributions, correlation, probable errors had all been given a first consideration. Truly astounding is the mass of work that followed, the more so when one remembers that it was not until 1911, when the Eugenics Record Office and its staff under Prof. Pearson's supervision had been already for some years in existence, that the will of Francis

Galton made possible the endowment of the Galton professorship of eugenics, of which he inevitably became the first holder and with which his name is now chiefly associated; not until then was he able to drop the immense burden of lecturing necessitated by the duties of the Goldsmid chair. The first number of *Biometrika* was issued in October 1901, and it has now completed a nominal twenty-seven but actually twenty-eight volumes; a mere glance through the tables of contents will show how largely Pearson's own contributions bulk therein. But memoirs were still contributed to the *Phil. Trans.*, the *Phil. Mag.*—contributions to that magazine including the notable and much discussed paper on testing goodness of fit—and elsewhere; and there was a whole host of Eugenics Laboratory Publications, as well as Drapers Company Research Memoirs; the Biometric Series, "Studies in National Deterioration", "Tracts for Computers", and "Questions of the Day and of the Fray". 'K.P.' was a born fighter, and the vigour of his onslaught not unnaturally led to retaliation in kind and consequent heat; but any bitterness generated and not already dissipated by the passing years will not survive his death.

The "Technical Series" of laboratory publications also ought not to go without mention: the memoirs on stresses in hooks, on masonry dams, on metal arches and other subjects, witness to Pearson's continued interest in elasticity notwithstanding the new line of work. Of his scientific works in volume form, the "Grammar of Science" (1883 and later editions) exhibits admirably the originality and logic of his thought and the clarity of his exposition. "The Chances of Death and other Studies in Evolution" (1887) is an amazingly varied collection of essays on subjects as diverse as death, roulette, sociology and folk-lore. Finally, there is the monumental "Life of Francis Galton", the finest tribute that could have been paid by the first holder of the chair to the founder whom he so honoured and loved. Though it scarcely falls within the category of his scientific writings, no one who wishes to know the man can neglect "The Ethic of Freethought" (1887, 1901), a collection of essays on history, philosophy and sociology.

Little more than two years ago Pearson described himself as "an adventurous roamer", and the phrase fits the man whose subjects ranged from Maimonides and the Veronica portraits of Christ to elasticity and statistics, and who could say: "In Cambridge I studied Mathematics under Routh, Stokes, Cayley and Clerk Maxwell—but wrote papers on Spinoza. In Heidelberg I studied Physics under Quincke, but also Metaphysics under Kuno Fischer. In Berlin I studied Roman Law under Bruns and Mommsen, but attended the lectures of Du Bois Reymond on Darwinism. Back at Cambridge I worked in the engineering shops but drew up the schedule in Mittel- and Althochdeutsch for the Mediæval Languages Tripos." The earliest contributions to the columns of NATURE that I have traced—and he was a not infrequent contributor in older days—are a letter (February 9, 1882) on the similarity of descriptive adjectives applied to colours and sounds, and a second (July 24, 1884) on apparently intelligent behaviour by a jay! The variety of his work is as striking as its mass. Only a scion of such vigorous stock could have produced it, or could have continued producing to the end of so long a life.

No old pupil of his will ever forget the lucidity and originality of Pearson's lectures; as another of them has written in *The Times*, he was no text-book teacher. In point of fact, neither for the matter of his lectures to engineers nor for his lectures on statistics, in the early days at least, were there any text-books. His early students in statistics—and I have no reason to suppose that matters altered afterwards—often had the privilege of listening to the first tentative steps in work which afterwards took shape in memoirs. It is sometimes said to the disadvantage of a non-resident university that there is little intercourse between teacher and taught, and little influence of the teacher beyond the classroom walls. Any such statement would be quite untrue of 'K.P.'; intercourse there was, the influence of his arresting and dominating personality went far beyond the classroom, and his tireless enthusiasm was infectious. Many of the makers and users of statistical methods all over the world to-day have been his pupils; more have learnt from his published work, and others again, as the years passed, have been pupils of his pupils.

Prof. Pearson was elected to the fellowship of the Royal Society in 1896, and awarded the Darwin Medal in 1898. In 1903 he was elected an honorary fellow of King's College, Cambridge. He was an honorary LL.D. of St. Andrews, an honorary D.Sc. of London, and an honorary member of the Anthropological Societies of Paris, U.S.S.R. and Washington. In the Galton chair, which he resigned in 1933, he was succeeded by Dr. R. A. Fisher, but his son Dr. E. S. Pearson was appointed to a new professorship of statistics.

G. UDNY YULE.

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THE death of Prof. T. Terada on December 31, 1935, has deprived Japanese science of one of its most active and useful students. Born of a noble family in Tokyo on November 28, 1878, he studied experimental physics in the Imperial University of that city. In 1909, he received the degree of doctor of science, and in the following year left for a course of two years' training in cosmical physics in Europe and America. In 1916, he was appointed professor of physics in the Imperial University. He was one of the principal founders of the Earthquake Research Institute. Though, for more than twenty years, he suffered from serious illness, Terada's scientific memoirs are very numerous and cover a wide range of subjects, including seismology, oceanography, meteorology, terrestrial magnetism, etc. They are now being collected by a committee of friends and former pupils, and, when published, will fill about twenty volumes. Of scarcely less value, however, was the advice that he gave to his friends and students, who bear cordial witness to this assistance in many a memoir published in the *Bulletin* of the Earthquake Research Institute.

# News and Views

## Sunspots and Wireless Fade-Outs

ATTENTION may be directed to a coincidence between a fade-out reported by the B.B.C. as having taken place between $16^h50^m$ and $17^h00^m$ U.T. on April 8, 1936, and a large sunspot, just visible to the naked eye, which was observed crossing the central meridian of the sun at about that time. It should, of course, be understood that there is not a one-to-one correspondence between fade-outs and sunspots, any more than there is between large terrestrial magnetic storms and large sunspots. An extremely useful report entitled "Quatrième Rapport de la Commission pour l'Étude des Relations Entre les Phénomènes Solaires et Terrestres" has recently been issued by the Conseil International des Unions Scientifiques, which gives a number of short articles dealing with relations between various pairs of solar and terrestrial phenomena. The subject is an extremely tangled one, as both magnetic storms and wireless phenomena show some correlation with the solar rotation period, without showing a strict one-to-one correspondence with any recognisable solar feature. It will be remembered that Greaves and Newton found a stronger correlation between the strongest storms and spots than they found between moderate magnetic storms and moderate spots. The magnetic activity shows, as is well known, in addition to the 11-year sunspot period, a well-marked twenty-seven day recurrence (the period being that of the solar rotation) as do, of course, the spot numbers, but a period of intense magnetic activity is not necessarily one of marked spot activity.

A CONNEXION between radio fade-outs and eruptions of bright hydrogen has been looked for recently. For example, a fade-out in the United States on August 30, 1935, coincided with the central passage of a bright hydrogen eruption, both being repeated on October 24, but as R. S. Richardson remarks, it must be emphasised that Mt. Wilson Observatory has photographs of much larger and more brilliant outbursts with no apparent terrestrial effects. A recent coincidence of this nature was described at the February meeting of the British Astronomical Association, but Mr. Greaves emphasised the necessity of accumulating data rather than attempting to establish a correlation on a few such coincidences. The disturbances in the magnetic elements and the fade-outs are alike attributed to changes in the ionosphere, and it is now supposed, following the results of the 1932 eclipse, that the earth's upper atmosphere is ionised by ultra-violet radiation from the sun; indeed, in order to account for certain features of the ionosphere, Prof. M. N. Saha, at a recent meeting of the Royal Astronomical Society, offered the suggestion that the lines in the extreme ultra-violet solar spectrum (of wavelength about 1000 A.) are emission lines and not absorption lines. If the ionosphere is only affected by very short wave-lengths, the correlation lies between terrestrial phenomena and *extreme* ultraviolet solar activity, the latter being unfortunately unobservable, as the ozone layers cut off this region of the solar spectrum before it reaches the surface of the earth. As to the detail of Saha's suggestions, whether the far ultra-violet lines are emission lines or not (it is hoped to test this matter by observations made in balloons at a height of 30 km.) the facts so far as they are known, particularly the 27-day recurrence of the fade-outs and magnetic activity, suggest very strongly a connexion between terrestrial activity and the far ultra-violet activity, the correlations between terrestrial activity and other solar phenomena being of a secondary character.

## England to South Africa Flights

MRS. MOLLISON completed her flight from Cape Town to London by the East Coast route (see NATURE, May 16, p. 821) on May 15, when she landed at Croydon at 1.36 p.m.; her time for the flight was 4 days 16 hours 17 minutes, which is more than a day and a half better than the previous record. The time for flying from England to southernmost Africa and back has thus been reduced to eleven days, three of which were given to rest in Cape Town. This flight, in a Percival 'Gull' aeroplane with a De Havilland 'Gipsy Six' engine, inspires an interesting examination of the technical development of air travel since the first flight between London and South Africa was accomplished. The pioneer flight was made by Wing-Commander H. A. Van Ryneveldt in a Vickers Vimy, two Rolls Royce engines of total 750 horse-power, taking 45 days, early in 1920. The increase of speed that primarily has made this possible comes from progress in aerodynamic design in reducing resistance that absorbs horse-power in overcoming it, and improvements in engine design, both in efficiency giving low fuel consumption and reduction of weight per horse-power. Thus, it has been possible to increase the air endurance of the average aeroplane, giving longer flight stages between stops for refuelling.

IMPROVEMENTS in instruments, radio direction finding equipment and such aids to navigation have helped in keeping the pilot to the shortest distance between the landing places, thus avoiding time wasted through losing the way, particularly after dark. In this case the development of ground organisation has played an equally important part. Facilities for refuelling, general servicing of the machine and such attentions, now normally available all along the route, have further helped to avoid delays. This does not, of course, detract from the magnificent feat of endurance, both physical and mental, of Mrs. Mollison. The actual time record for this route was made

by Squadron Leader Gayford and Flight-Lieut. Nicholetts in a Fairey monoplane, with a Napier engine, in February 1933. This flight finished at Walvis Bay, only just short of Cape Town, taking 2 days 9 hours 25 minutes. This machine was specially built and equipped for experimental long-distance non-stop flights, and was not entirely a practicable proposition for average everyday flying.

### Science in a Changing World

THE Friday evening discourse at the Royal Institution on May 22 was delivered by Sir Richard Gregory, editor of this journal, who took as his subject "Science in a Changing World". Every week the correspondence columns of NATURE include announcements of new experiments and observations carried out by the authors in various parts of the world. Since its foundation by Sir Norman Lockyer in 1869, this journal has been the recognised medium for recording such advances in natural knowledge and for the discussion of scientific questions raised by them. Each volume of the hundred and thirty-six which have been published contains noteworthy communications of this kind, and a few of them were mentioned in the discourse. A new era in the history of physical science began just forty years ago. Within a few months, the discoveries were announced of argon, helium, X-rays and radioactivity. It was in the columns of NATURE that Lord Rayleigh first directed attention to the differences of density between nitrogen obtained from the air and from chemical sources which led to the announcement in 1895 of the discovery of argon. Sir William Ramsay also announced there his extraction of helium from the mineral cleveite—twenty-seven years after it had been found by Sir Norman Lockyer in the sun.

THE first translation into English of Röntgen's paper "On a New Kind of Rays" was published in this journal, and also the first suggestion that cathode rays offered the most promising means of producing distant optical vision—now called television. It was in 1908 that Mr. A. A. Campbell Swinton described how cathode ray tubes might be used for this purpose; and his device has now been successfully developed for the transmission and reception of television programmes, such as will shortly be available from Alexandra Palace. Many scientific discoveries, however, have not added to the amenities of life but to its degradation. Sir Richard Gregory urged, therefore, that it has become the duty of men of science to adjust themselves to the conditions of a changing world, and to take an active part in promoting worthy uses of scientific discoveries and preventing the application of new forces to purposes of destruction.

### Freud and the Anthropologist

To mark the occasion of Sigmund Freud's eightieth birthday on May 6, Dr. Géza Róheim, perhaps the most distinguished, and certainly the most experienced exponent of the application of Freud's theories to field investigation in anthropology, evaluates in *Man* of May his master's contribution to the principles of research among primitive peoples. It is interesting to note that Dr. Róheim, pointing to the fact that the anthropologist's criticism of Freud has been directed mainly against his version of the 'primitive horde' or Cyclopean family, does not himself believe that psycho-analytic anthropology stands or falls with this view of human origins. This is explained in part by Dr. Róheim's general position. Not only does he hold that Freud's minor papers would explain certain problems to the anthropologist, if the anthropologist would only grasp these explanations; but also he maintains that the real significance of Freud for the anthropologist does not lie in his contributions to anthropology. The explanation of the apparent paradox is that he stresses Freud's technique as his greatest contribution to the science. In the employment of psycho-analysis he has elaborated a method to explain personality. If, as is now admitted on an overwhelming mass of evidence, this method is valid as applied to Europeans, we must believe a priori that it is applicable at least as a method of investigation to savages, the fundamental psychological unity of mankind being taken for granted. Further, he goes on to point out, as a matter of practice it has been abundantly demonstrated that the dreams of primitive people can be analysed according to the same method and with the same results as the dreams of Europeans. Finally, perhaps the most important point in relation to understanding of the method, Dr. Róheim indicates in response to criticism from the 'functional' school, how and in what sense the term 'neurosis' is not merely individual, but is to be taken as applicable to the group.

### U.S. National Academy of Sciences: New Members

THE *following have recently been elected to the* U.S. National Academy of Sciences: Prof. Leo H. Baekeland, honorary professor of chemical engineering in Columbia University; Prof. Eliot Blackwelder, professor of geology in Stanford University; Prof. I. S. Bowen, professor of physics in the California Institute of Technology; Dr. Wallace H. Carothers, research chemist in E. I. du Pont de Nemours and Co.; Prof. Alexander Forbes, associate professor of physiology in Harvard University; Prof. W. F. Giauque, associate professor of physical chemistry in the University of California; Prof. Clark L. Hull, professor of psychology in Yale University; Prof. Edwin O. Jordan, chairman of the Department of Bacteriology at the University of Chicago; Dr. A. V. Kidder, chairman of the Division of Historical Research of the Carnegie Institution; Prof. Warren H. Lewis, research associate of the Carnegie Institution and professor of physiological anatomy in Johns Hopkins University; Prof. Robert S. Mulliken, professor of physics in the University of Chicago; Prof. W. C. Rose, professor of physiological chemistry in the University of Illinois; Prof. Edmund W. Sinnott, professor of botany in Columbia University; Prof. J. L. Walsh, associate professor of mathematics in Harvard University; Dr. Orville Wright, known for his pioneer work on the aeroplane.

**Excavations at Armant, 1935-36**

IMPORTANT discoveries are announced in the report of the expedition of the Egypt Exploration Society to Armant, which has been at work in Upper Egypt since last autumn under the direction of Mr. Oliver Myers. The expenses of the expedition were borne entirely by Sir Robert Mond. It had three objectives. Of these the first was unsuccessful. A fortnight's search failed to find graves containing the Saharan pottery, of which sherds are found scattered on the low desert. The settlements and graves of these people seem to have weathered away; but it is probable that they visited Egypt before the known Pre-dynastic periods. The second object was to investigate the origins of the combed burnished pottery closely resembling Badarian. This proved to belong to an intrusive people of the Proto-dynastic period. More than a hundred graves were opened, and although the top of the cemetery had been removed and the contents disturbed, so that no object of intrinsic value was retrieved, what remained was of the greatest interest. The people were small, and may have been of two distinct races. Possibly they practised bull-worship, for the more important members of the tribe were buried with their cattle. The oxen were crouched in pear-shaped graves facing the main burial. The pottery had the incised chevron pattern around the rim; and some showed the incised white decoration found on the Nubian pots of the Middle Kingdom. Agate lunates hafted to form arrows resemble those from the tomb of the wazir of Den of slightly later date.

THE expedition's greatest success, however, was achieved in the town, where the site of Cleopatra's lake was discovered without difficulty. A hollow filled with green putrid water in the middle of the town, still sacred as having curative properties, soon showed on excavation the walls, preserved to within two or three metres of the original surface, with a stairway leading down one side. Dressed stones in the *suq* square proved to be part of a pylon of Tothmes III, celebrating his victories over the Nubians. Among other representations of his spoils is the first known example in Egyptian art of the rhinoceros, its capture being described on a neighbouring stela. Among other notable finds are a record of two additional *set* festivals of Rameses II, and a cubit divided duodecimally, antedating the supposed introduction of this method of division by the Greeks by a thousand years.

**Zoological Society of London**

THE 107th annual report of the Zoological Society of London for 1935 submitted to the annual meeting on April 29 contains records of the breeding of more than fifty species of mammals, twenty birds and five reptiles at Regent's Park, and twenty-seven species of mammals and seven of birds at Whipsnade. The pathological report records that out of an average population of 824 mammals and 1,631 birds, 215 mammals or 26 per cent, the lowest for the past ten years, and 539 birds or 33 per cent, died and were examined by the department. Injuries and accidents accounted for 183 or 20·2 per cent of the deaths, digestive diseases for 142 or 15·6 per cent, and respiratory diseases for 138 or 15·2 per cent. Two monkeys, two antelopes, a wild pig, a hedgehog and a desert cavy died of tuberculosis; twenty-one birds and a reptile of mycosis; nineteen mammals, five birds and three reptiles of rickets and bone diseases; two mammals and thirty-five birds of urinary diseases; seven mammals, twenty-four birds and two reptiles of blood and circulatory diseases. Eight of the birds died of old age, including a snowy egret which had lived nearly fifteen years in the Gardens, and an Indian kite which had lived there more than fourteen years. Four mammals, including the rare okapi, ten birds and nine reptiles died from parasites. A new elephant house to replace the 1869 building is to be completed by 1937, while original ideas to be carried out at Whipsnade include open air collections of chimpanzees and gibbons on islands with growing trees; as these apes will not cross water, visitors will be able to watch them without intervening bars. In a Studio of Animal Art, to be built near the Society's offices, living models of lions, tigers and other creatures will be available for classes of up to twenty-four students.

**Present State of Bird-Ringing in Britain**

IT will be interesting to see if the number of wild birds ringed in 1935 for migration study in the British Isles, namely, 46,430, the first decline for many years, 1934 having 49,651, approaches the limit of work possible for field ornithologists working without financial assistance from official bodies. Of the leading ringers, Dr. H. E. Moon, of Cumberland, marked 5,205 birds (1,762 song-thrushes, 970 lapwings, 877 blackbirds, 379 starlings and 154 swallows), and excepting 1934, he has marked more birds than any other ornithologist each year since 1924 (*British Birds*, April 1936). Since bird-ringing began in Great Britain under the organisation of H. F. Witherby in 1909 (when 2,171 birds were marked), 482,510 birds have been ringed, chiefly nestlings; but the proportion of adult birds is increasing with the use of small 'traps' and bird-observatories, last year's totals including 30,364 nestlings and 16,066 'trapped' birds. Of the total number of birds ringed since marking began, the leading figures are: song-thrush 53,108, blackbird 42,469, starling 37,592, swallow 34,243, lapwing 27,928, chaffinch 19,684, greenfinch 18,643, redbreast 17,008, common tern 15,245 and black-headed gull 12,902, Sandwich tern 11,630, hedge-sparrow 11,317, house-marten 9,996, willow-warbler 8,492, linnet 7,659, yellow bunting 3,953. The proportion of recoveries is not always the same, and out of 3,037 spotted flycatchers marked, only seven have been recovered, only one out of 1,092 garden-warblers, and one out of 625 grey wagtails, while out of 1,337 arctic terns marked, two have been recovered, and out of 8,492 willow-warblers three have been reported. In some species the recoveries reached 23 per cent.

**Institute of Physics**

THE annual general meeting of the Institute of Physics was held on Tuesday, May 19. After election of the officers and completion of the panel of the Board, it was announced that the following would take office on October 1, 1936: *President*, Prof. A. Fowler; *Vice-President*, Mr. F. Twyman; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Colonel K. W. E. Edgcumbe and Prof. R. Whiddington. The annual Report for the year 1935 which was adopted at the meeting shows that membership has continued to increase and that the high standard required for corporate membership has been maintained. The total membership at the end of the year was 822. The first Industrial Physics Conference to be held in Great Britain took place in Manchester in March 1935, and the attendance was nearly 550. The subject of the Conference was "Vacuum Devices in Research and Industry", and an exhibition of instruments, apparatus and books cognate to the subject was arranged and was open to the public. Some 3,500 people visited the exhibition. A Midland Local Section was inaugurated in November, the towns covered being Birmingham, Leicester, Nottingham and Rugby. The Report shows that the scheme for the training and certificating of laboratory assistants has developed satisfactorily and 21 certificates were issued during the year. The Institute's services in placing employers in touch with physicists seeking permanent posts and with consultants were in constant demand throughout the year. The circulation of the *Journal of Scientific Instruments* increased during the year, both on account of the commencement of its distribution to 'associates' without extra payment and on account of sales to non-members.

**The Education of Naval Architects**

AT the recent meeting of the Institution of Naval Architects, Mr. L. Woollard gave an account of the methods of training naval architects in Great Britain to-day in Admiralty establishments, at the universities and at the various technical colleges. As is well known, the Admiralty more than a century ago took the lead in technical education, and the work of the schools in the dockyards, at South Kensington and Greenwich, has been reviewed at various times by Sir William White, Sir William Smith and Sir Arthur Johns. To-day, however, there are courses for degrees in naval architecture at the Universities of Glasgow, Durham and Liverpool, while there are no fewer than seventeen technical schools or colleges in England and Scotland where courses can be followed for the National Certificates in Naval Architecture. These certificates are awarded by a Joint Committee of the Institution of Naval Architects and the Worshipful Company of Shipwrights, in conjunction with the Board of Education or Scottish Education Department. Mr. Woollard gives particulars of the courses followed at the R.N. College, Greenwich, and elsewhere, the scholarships open to students and a list of papers and articles in the education of naval architects. When referring to Admiralty training, he says that experience has shown that candidates have more difficulty in satisfying the examiners in mathematics than in the other subjects, and students weak in mathematics find great difficulty in keeping pace with the courses at Greenwich.

**Uniformity as the Gauge of Quality**

IN a paper read to the Institution of Electrical Engineers on May 1, Mr. C. C. Paterson pointed out that there is always a tendency to judge a manufactured product by its showing one desirable feature rather than from its uniformity. He said that with certain exceptions, such as the laws of gravity, there is a remarkable absence of uniformity throughout Nature. There is a tendency to admire extremes, such as the tallest mountain or the longest river. This explains why there is a certain distrust in the pursuit of uniformity. The engineer is rather apt to take it for granted. Much attention is paid to class-testing, but the same effort is not made to ensure that every product is up to the level of the class tested. In the case of electric boiling plates, for example, if the supply voltage is 6 per cent low the consumption of energy compared with the heat developed is increased 14 per cent. Variations such as these are superimposed on the manufacturers' permissible limits of variation now called 'tolerances'. Fifteen years ago, the manufacture of glass was largely a matter of rule of thumb methods, with the result that in making lamps about 150 bulbs were used for every 100 lamps. When an effort was made to obtain glass of uniform quality with the desired characteristics, only 104 bulbs were used for each 100 lamps produced. In the early days of dry battery manufacture, great stress was laid on individual output. With the growing use of multicellular batteries, where failure of any unit meant failure of the whole battery, attention was concentrated on securing uniformity, with the result that the failures now are of the order of five in a million. In conclusion, Mr. Paterson dwelt on the importance of using frequency curves when assessing the deviation of products from the standard. Instead of using tolerances, it would be much better to adopt the coefficient of variation or the standard variation from the frequency curve by the method used by statisticians.

**Influence Lines**

IN the analysis of beams and girders it is possible by the method of influence lines to simplify the process of determination of the stresses due to the passage of a system of rolling loads. In such cases the preparation of diagrams of maximum bending moment and shear force is usually a laborious matter; whereas it is eminently simple to construct a bending moment influence diagram which, for a particular section, will show the bending moment at that section due to a load of one ton placed at any point in the beam. For the given section the one diagram serves each and every load, but while the use of influence lines is generally referred to in structural engineering textbooks, the special technique required in their applica-

tion to a given problem and their interpretation receives little or no attention. There is now available, however, a handbook ("The Application of Influence Lines to the Stress Analysis of Beams and Lattice Girders." By R. McCrae. Part 1. Pp. 42. (London: The *Draughtsman* Publishing Co., Ltd.) 2*s*.) which discusses fully their practical uses as they might be of advantage to a designer. The first part, which is now issued, deals with beams only. The author's primary object in Part 1 has been to provide the reader with a knowledge of the fundamental principles underlying the conception of influence lines. He shows how simple it is to construct the diagram for all cases and how the maximum effects due to rolling and distributed loads can be deduced. In the matter of units, it would have been an advantage to have described the ordinate of the bending moment influence line as representing ton-foot units per ton, so that when multiplied by the appropriate load the result is rational. Those who have been in the habit of using the bending moment diagram will at first find the influence line somewhat unorthodox but, once masters of the system, will doubtless agree as to its advantages, particularly in saving time and eliminating errors, and will appreciate the detailed treatment given in this publication.

### A Clarity Tester for Gelatine

THE introduction of the various forms of rectifier photo-electric cell has certainly simplified many problems in the use of instruments such as colorimeters (chemical type), densitometers and the like, since currents of the order of 100 microamperes can be attained without very intense light, the cell acting, when suitably illuminated, as a primary source of direct current without the use of batteries. Many such applications have now been developed. A convenient instrument of this type has been recently designed by Messrs. Imperial Chemical Industries, Ltd., and put on the market by Messrs. Baird and Tatlock (London), Ltd., for the testing of the clarity of gelatine and other aqueous solutions. It is well made and easy to operate, and should be found of great assistance in saving time in such tests as well as in giving much better accuracy than visual comparisons. No doubt more or less empirical scales would have to be established for particular types of product, and in instruments of this kind (as indeed in visual photometry) it will be important to avoid confusion between scattering and direct absorption of light.

### Butane Gas Supply in Rural Areas

IN an article in *Engineering* of May 8, Mr. Theodore Rich gives an account of the development of the use of bottled butane gas in rural areas with no gas or electricity supply in France, the United States and Great Britain. Butane ($C_4H_{10}$) can be obtained from natural gas, crude oil or coal; it liquefies under a pressure of 23 lb. per sq. in. at 60° F. At a temperature of 104° F. the pressure of liquefaction is only 62 lb. per sq. in., and it can therefore be delivered to customers in comparatively light steel bottles. In France the bottles contain 28·6 lb. of liquefied gas, which has a heat content of 21·590 B.Th.U. per lb. The cost works out at about 3*s*. a therm. It is distributed by several thousand agents, and the gas is used particularly for cooking, one bottle containing sufficient gas to cook for a family of three persons for six or seven weeks. At the Paris Fair of May 1935, practically every maker of gas stoves showed apparatus for the use of butane. The manufacture of butane and isobutane in Great Britain has been undertaken by Imperial Chemical Industries, Ltd., at Birmingham, and the gas is being marketed as 'Calor' gas. Butane can be used for gas fires, geysers and for house lighting, and in the villages of Smalldole in Sussex, Stokesley near Middlesbrough and Hay in Brecknockshire, it has been applied to street lighting.

### Solid *v*. Liquid Fuels

IT is one of the characteristics of our times that science and technical effort make us largely independent of geographical circumstances. Products not occurring naturally may be synthesised, and under the plea of national self-sufficiency much may be done, even although entirely uneconomic when judged by former standards. Many things can be done with liquid fuel which are difficult or impossible with solid, and the natural result has been the development of the oil industry. The latest phase is the synthesis of liquids from coal by hydrogenation, and the technical merit of this achievement is apt to obscure the economic aspect. There are, however, still those who insist on the reversion to old standards, and a pamphlet issued by the Liberty Restoration League, 24 Essex Street, London, W.C.2, makes a plea for the return to coal and its products in place of oil for all purposes. It is claimed that the use of liquid fuels on land, sea and air is largely maintained by subsidy, open or concealed, which should be recognised and even curtailed. Much of the plea cannot be gainsaid, but neither the State nor the individual is likely to forgo powers conferred by liquid fuels. There is much to be said for greater efforts to transfer coal into products now in demand, but it is wholesome that the cost should be clearly understood.

### Institute of Wireless Technology

THE annual general meeting of the Institute of Wireless Technology took place on April 30. Mr. James Nelson was elected president for the ensuing year and Mr. B. Tunbridge Hogben was re-elected hon. treasurer. The annual report showed a further increase of membership, and in particular it was noted that the student membership had increased to a greater extent in 1935 than in any previous year. The number of candidates for the associateship and associate membership examinations also showed an increase for the year under review. It should be mentioned that the subject of television has been included as a special subject for several years past, and this is believed to be the only examination for television engineers to be held by any professional institution in the country. The presidential address was entitled "The Value of the Institute to the Profession and Industry".

### Royal Aeronautical Society Anniversary Exhibition

A SPECIAL exhibit, which has been formed by the Royal Aeronautical Society to mark the seventieth anniversary of its foundation, was inaugurated in the Science Museum, South Kensington, on the occasion of the Society's annual reception on May 21, and will be available to the public until June 22. The exhibit comprises aeronautical objets d'art, aeronautical trophies, medals, engravings, stamps and rare or unique articles connected with ballooning and aviation, many of which have been lent by private collectors. The Society will show the first Council Minutes (January 12, 1866) and MSS. relating to outstanding events in its history; the first pilot's certificate issued in Great Britain and granted to Lieut.-Col. J. T. C. Moore-Brabazon—now president of the Society—will be included.

### Scientific Instruments in Relation to Textiles

DURING Whit-week, the Textile Institute is holding its annual Conference in London, and in association with this event, it has been arranged to hold an exhibition of apparatus, and testing devices for scientific and industrial research in relation to textiles. The exhibits will be staged at the headquarters of the Conference, the Hotel Victoria, Northumberland Avenue, London, W.C.2. The exhibition will be opened by Dr. Harry Moore, director of research of the British Scientific Instrument Research Association, at 3 p.m. on June 3, and remain open until 9 p.m. On June 4 and 5 the exhibition will be open from 10 a.m. to 7 p.m. The exhibits will include a ring wool friction testing machine; whirling-light rotoscope; hygrometers; thermographs; recording pyrometers, pressure gauges, trichromatic colorimeter; microscopes; time regulators; ultra-violet equipment; X-ray apparatus; colour comparators; spectrophotometers; colloid mills; and devices for controlling and recording temperature, humidity and pressure. A descriptive catalogue of exhibits will be issued free to all visitors. Further particulars and tickets of admission are available from the Textile Institute's headquarters at 16 St. Mary's Parsonage, Manchester 3.

### Gift to the Royal College of Surgeons

A GENEROUS donation of £25,000 has been made by the Bernhard Baron Trustees to the Royal College of Surgeons for the erection of new research laboratories. This gift will, by the provision of additional and up-to-date facilities at the College, give a further impetus to research on problems of surgical interest. A research institute for surgery in the centre of London will provide opportunities for those interested to carry on their investigations under the best possible conditions. In this way, the College will have in the future an increased share in the maintenance of London's reputation as one of the great centres of surgical treatment and research.

### Medal Awards at the Franklin Institute

AT a meeting of the Franklin Institute, Philadelphia, on May 20, the following medal awards were made: *Franklin Medals* to Dr. Frank Baldwin Jewett, vice-president of the American Telephone and Telegraph Company and president and director of the Bell Telephone Laboratories, for his many important contributions to telephony alone and in collaboration with other workers in the great laboratory of research which he has directed with such signal success, and to Dr. Charles Franklin Kettering, vice-president and director of the General Motors Corporation and general director of the General Motors Research Laboratories, Detroit, for his contributions to the science of automotive engineering; *Elliott Cresson Medals* to Dr. George O. Curme, jun., of Carbide and Carbon Chemicals Corporation, New York City, for his work on synthetic aliphatic compounds based upon the olefines as starting material and their use in industry, and to Dr. Robert J. Van de Graaff, of the Massachusetts Institute of Technology, for his development of an electrostatic generator for the production of high-voltage direct currents; *Edward Longstreth Medals* to Dr. Alfred V. de Forest, president of the Magnaflux Corporation, New York City, associate professor at the Massachusetts Institute of Technology; Major William E. Hoke, consulting engineer, Baltimore, for his work on a method of detection of hidden defects, primarily at or near the surface of magnetic materials; Peter P.-G. Hall, president of the Hall Planetary Co., Philadelphia, for his invention and development of machine and cutters for planetary milling and threading; Elmer A. Sperry, jun., vice-president of Sperry Products, Inc., Brooklyn, N.Y., for his development of blind-flying instruments employing gyroscopic principles; *John Price Wetherill Medal* to Albert L. Marsh, president of the Hoskins Manufacturing Co., Detroit, Michigan, makers of electric furnaces, pyrometers and resistance wire; *Walton Clark Medal* to Dr. Joseph Becker, of the Koppers Construction Company, Pittsburgh, Pa., for his improvements in the art of carbonisation of coal and manufacture of gas in coke ovens, and particularly for his work in the development of the oven known as the 'Becker Oven'; *Louis Edward Levy Medal* to Mayo D. Hersey, of Brown University, for his papers on the theory of lubrication, published in the June, July, August and September issues of the *Journal* of the Institute for 1935; *Howard N. Potts Medal* to Dr. Felix A. Vening Meinesz, Amersfoort, Holland, professor of geodesy and geophysics at the University of Utrecht, for his work in geodesy, and for the development and use of apparatus for determining gravity at sea.

### Announcements

SIR ROBERT HADFIELD has been elected a foreign member of Group 1 (Mathematical and Natural Sciences) of the Norwegian Academy of Sciences and Letters. This group of the Academy is limited to 110 Norwegians and 100 foreigners; among the latter are Sir William Bragg, Sir Frederick Gowland Hopkins, Lord Moynihan, Lord Rutherford, Sir Napier Shaw, Sir Grafton Elliot Smith and Sir J. J. Thomson.

THE honorary gold medal of the Royal College of Surgeons has been awarded to Dr. J. A. Murray "in appreciation of his services as director of the laboratories of the Imperial Cancer Research Fund". Mr. R. B. Wade, president of the Royal Australasian College of Surgeons, has been elected into an honorary fellowship of the College.

DR. ALBERT DEFANT, professor of oceanography and geophysics at the University of Berlin, has been elected a foreign member of the Swedish Society of Anthropology and Geography, and has been awarded the Galathea Medal of the Royal Danish Geographical Society of Copenhagen.

AT a council meeting of the Royal Aeronautical Society held on May 12, Mr. H. E. Wimperis, director of research in the Air Ministry, was elected president for the year 1936–37. At the same meeting, Mr. F. Handley Page was elected a vice-president of the Society for the year 1936–37, and Major T. M. Barlow was re-elected vice-president for a further year of office.

PROF. A. KOPFF, professor of theoretical astronomy in the University of Berlin, will deliver the George Darwin Lecture at the ordinary meeting of the Royal Astronomical Society on Wednesday, June 10, taking as his subject "Star Catalogues, especially those of Fundamental Character."

DR. C. MONTAGUE COOKE, jun., malacologist on the staff of Bernice P. Bishop Museum, has been elected corresponding member of the Natural History Museum, Vienna, in recognition of his publications and work in assembling materials and records relating to Pacific land snails.

MR. H. J. PAGE has been appointed to succeed Lieut.-Col. B. J. Eaton, who is retiring shortly from the post of director of the Rubber Research Institute, Malaya. Mr. Page, who is at present controller of agricultural research at the Agricultural Research Station maintained by Imperial Chemical Industries, Ltd., at Jealotts Hill, will be leaving England for Malaya in July next.

ON the occasion of the visit to Bath on May 16 of the Section of the History of Medicine of the Royal Society of Medicine, Sir D'Arcy Power unveiled a memorial tablet of John Hunter on the wall of 12 South Parade, where Hunter lived in 1785, and Dr. F. G. Thomson delivered an address on some early Bath physicians and their times.

PROF. E. V. APPLETON will deliver three lectures on "Some Problems of Radio Communication" in the Fyvie Hall of the Polytechnic, Regent Street, London, on Thursdays, June 11, 18 and 25 at 6.30 p.m.

THE following appointments have recently been made by the Secretary of State for the Colonies: W. F. Steven, to be plant pathologist, Agricultural Department, Gold Coast; J. M. W. Ware, to be veterinary officer, Department of Animal Health, Gold Coast.

THE German Society of Natural Science and Medicine will hold its annual Congress at Dresden on September 21–24.

A SCHOOL for Sanitary and Social Education was opened on March 7 at Prague at the expense of the State, supported by the Rockefeller Foundation.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A tutor in mathematics in Loughborough College, Leicester—The Registrar (May 25).

A teacher of engineering in the Technical College, Walthamstow—The Clerk to the Governors, 263 High Street, Walthamstow, E.17 (May 25).

A lecturer in mechanical engineering (aerodynamics and aircraft design) in the Coventry Technical College—The Director of Education, Council House, Coventry (May 28).

A teacher of mathematics in the Northern Polytechnic, Holloway, London, N.7—The Clerk (May 29).

An assistant lecturer in engineering in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (May 30).

A junior scientific officer in the Wood Chemistry Section of the Forest Products Research Laboratory, Princes Risborough, Aylesbury—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 30).

A demonstrator in botany in Westfield College, London, N.W.3—The Principal's Secretary (June 1).

An assistant lecturer and research worker in physiology in King's College, London—The Secretary (June 2).

Technical assistants (physics or engineering) at the Signals Experimental Establishment, Woolwich Common, S.E.18—The Superintendent (June 2).

Civilian technical officers (physics or engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote *C.E.* 2915/36) (June 6).

An assistant lecturer in geology (specially qualified in stratigraphy and palæontology) in the University of Birmingham—The Secretary (June 6).

A research assistant for investigation of the mackerel fisheries at the Marine Biological Laboratory, Plymouth—The Principal (June 10).

A lecturer in zoology in Armstrong College, Newcastle-upon-Tyne—The Registrar (June 13).

A mining engineer under the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, Westminster, S.W.1 (June 16).

A lecturer in physics in the Heriot-Watt College, Edinburgh—The Principal.

An assistant in the Intelligence Section of the Plant and Animal Products Department of the Imperial Institute, South Kensington, S.W.7—The Establishment Secretary.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 872.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Induced Radioactivity of Short Period

CRANE, Delsasso, Fowler and Lauritsen[1] have reported the existence of radioactive bodies of periods less than a second formed by bombarding lithium or boron with deuterons. They assume the active isotopes to be $^{8}$Li and $^{12}$B. It might be possible to produce these and perhaps other radioactive nuclei of short period by neutron bombardment, and it was thought desirable to investigate this question by means of a suitable arrangement.

The experiments were performed with an apparatus very similar to that used by Frisch in a search for similar effects produced by α-particles[2]. The neutron source (beryllium–radon) is placed 75 cm. from a thin-walled Geiger counter which is shielded from the direct beam by a 70 cm. bar of lead and from scattered radiation by surrounding with 8–10 cm. of lead. The semi-cylindrical samples of the elements to be examined are held by an arm, and can be swung from a position around the neutron source to a position around one side of the counter in 0·3 sec., the arm passing through a suitable slit in the lead shield. The movement is controlled by a pendulum the period of which can be changed from 1 sec. to 2–4 sec. Such an arrangement is suitable for the examination of induced radioactivity of period greater than 0·3 sec. With a neutron source of initial strength 350 millicuries, the following results were obtained:

*Beryllium.* Strong activity of half-value period $0{\cdot}9 \pm 0{\cdot}2$ sec. (determined by means of about three hundred oscillograph records of the decay). The effect is reduced to half when the β-rays pass through 0·4 gm./cm.$^2$ aluminium, indicating that their maximum energy is of the order of $6$–$8 \times 10^6$ e.v. The yield is of the same order as the yield from calcium fluoride bombarded with neutrons when the samples have equal thickness in gm./cm.$^2$; for example, the rate of counting during the counting period was about 400 per minute with a source of 130 millicuries, the γ-ray effect being 40 per minute. Surrounding the source with paraffin wax does not increase the effect.

The process leading to the active nucleus might be capture of the neutron by the $^{9}$Be nucleus with the emission of a γ-quantum, two neutrons, a proton, a deuteron or an α-particle, the active nucleus being $^{10}$Be, $^{8}$Be, $^{9}$Li, $^{8}$Li or $^{6}$He, respectively. $^{10}$Be can probably be excluded on account of reliable knowledge of the masses of $^{10}$Be and $^{10}$B, which are very nearly equal[3]. $^{8}$Li is excluded if the active body found by Crane *et al.*[1] is $^{8}$Li, for they found a β-ray spectrum with an upper limit of $10 \times 10^6$ e.v., which means that the neutrons bombarding $^{9}$Be would have to have an energy of some $13 \times 10^6$ e.v., assuming the masses given by Oliphant[3]; the beryllium–radon source does not yield such fast neutrons in quantities sufficient to explain the large effect found. It is difficult to decide between the other possibilities so long as the β-ray spectrum of the active body is not known. Experiments with an expansion chamber are intended. But it can be said that if the maximum energy is greater than $5{\cdot}5 \times 10^6$ e.v., the active body can scarcely be $^{6}$He, as its mass would then be greater than that of $^{4}$He plus two neutrons.

*Other elements.* The following elements have been examined, but no new activities have so far been found: Li, B, C, N, O, F, Na, Al, Cl, Fe, Ni, Cu, Zn, Se, Ag, Cd, Sn, Pb. Knol and Veldkamp have reported a weak activity induced in lithium by slow neutrons[4], but their experimental conditions (rotating wheel, counting lasting many hours) are difficult to compare with those of the present work.

I wish to thank the Technical Highschool of Denmark for a grant and the Radium Station for the gift of the emanation.

T. BJERGE.

Physical Laboratory,
Technical Highschool of Denmark,
Copenhagen.
April 30.

[1] Crane, Delsasso, Fowler and Lauritsen, *Phys. Rev.*, **47**, 887 and 971 (1935).
[2] O. R. Frisch, NATURE, **133**, 721 (1934).
[3] Oliphant, NATURE, **137**, 396 (1936).
[4] Knol and Veldkamp, *Physica*, **3**, 145 (1936).

## Collision Forces between Light Nuclei

IN the interpretation of experiments on anomalous scattering in terms of a field departing from the inverse square law at the closer distances, it has been usual to use, in the absence of evidence to the contrary, only forces of short range corresponding to $e^2/mc^2$. We are of the opinion that, if the current method of explanation is to be retained, forces of longer range must also be admitted. We have measured the angular distribution of scattering of the slower α-particles in hydrogen, deuterium and helium under similar conditions. Our calculations indicate that for all three gases the forces would have to act at distances greater than $10 \times 10^{-13}$ cm., although they need not be large until smaller separations are reached. The reason is, briefly, that in all cases the higher 'phase-constants' are important, so that even those particles which approach less closely can penetrate the anomalous region. We are grateful to Dr. J. A. Wheeler for informing us that he had also reached this result, independently, for helium.

It is perhaps worth noting that even in the collision of two elementary particles such as proton on proton, long-range forces may also be of importance. White[1], in discussing his experiments on the scattering of fast protons in hydrogen, is able to reach only a partial explanation with short-range forces of attraction. We have made approximate calculations using the field described by Infeld[2], and find that this gives a large enough negative phase-constant $K_0$ to account for the two main features, the large anomaly

at 45° and its rather rapid variation with energy. The calculated values are intermediate between White's and those of Tuve, Hafstad and Heydenburg[2], and as a qualitative explanation this seems as successful as that already given by Present[4] in terms of exchange forces. This is not strong evidence for Infeld's theory, since the main effect at these energies—up to 1,000 kv.—is due to the large repulsion at small distances near the critical radius $r_0$ ($1 \cdot 9 \times 10^{-13}$ cm.).

The interpretation of the scattering intensities by means of potential fields is not, moreover, incompatible with the existence of stable energy levels or of resonance levels which may be used in tentative models of compound nuclei, since the known binding energies and the phase-shifts of zero order can be reproduced with strong attractive forces at radii which need not exceed $2 \times 10^{-13}$ cm. The binding energies are not greatly affected by introducing long-range forces as well.

Forms of potential field which will meet all of these requirements in detail must await further investigation.

C. B. O. MOHR.
G. E. PRINGLE.

Cavendish Laboratory,
Cambridge. May 5.

[1] *Phys. Rev.*, **49**, 309 (1936).
[2] *Proc. Camb. Phil. Soc.*, **32**, 127 (1936).
[3] *Phys. Rev.*, **49**, 402 (1936).
[4] ibid., **48**, 919 (1935).

## Return of Radio Waves from the Middle Atmosphere

WE are glad to be able to confirm and amplify the indications given by Prof. R. C. Colwell and A. W. Friend in the letter which appeared in NATURE of May 9. One of us, in his address, as chairman, to the Wireless Section of the Institution of Electrical Engineers[1], has reported briefly on the initial stages of work for the Radio Research Board undertaken recently at Orfordness, a site the isolation of which permitted the use of substantial powers in short-duration pulses for the closer study of the lower regions of the ionosphere. In addition to the sporadic reflections from levels between 85 km. and 100 km. then reported, we have had under intermittent observation the very complex echo-systems which result from the return of radio waves from heights between 6 km. and 60 km.

We had, just before publication of the letter of Prof. Colwell and Mr. Friend, completed a preliminary communication on these studies, which we hope may be published at a very early date. Meanwhile we may say that we incline to recognise three distinct regions from which radio waves, up to very high frequencies, are returned within the range of height 6–60 km. The echoes from the lowest heights appear to belong to a system of multiple reflections from sharply defined heights which usually lie above 6 km., are not infrequently found at 10 km., and on a single occasion have been found so high as 14 km.

A second and apparently independent group of echoes returns from levels between 15 km. and 50 km., and we show in our forthcoming communication that this region is almost certainly replenished by local thunderstorms. The thunderstorm mechanism is probably involved also in the replenishment of the lower region, but much further study is necessary before the evidence about these two regions is unravelled; this remark applies, with perhaps greater force, to a third region which we recognise at about 60 km. This third region does not appear to be very closely related to either of the other two; it cannot, for example, be dismissed as a misinterpretation of second-order echoes from the 30 km. region.

Our work, which began in May 1935, and in which heights were first measured with some certainty on June 10, 1935, has been carried on to complete a year's observation, mainly in the frequency range 6–12 mc./sec.; in some isolated trials on notably higher frequencies—including those proposed for television services—we have not yet attained a frequency so high that its return from the middle atmosphere can be regarded as unusual.

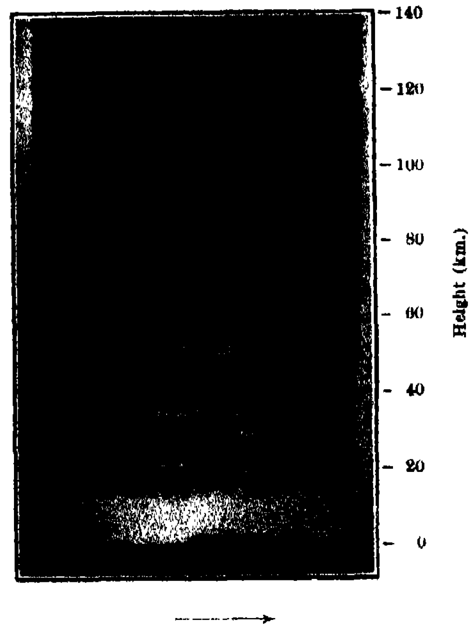


FIG. 1.

The accompanying illustration (Fig. 1) is a direct untouched reproduction from a continuous record of equivalent path against time ($P't$); the portion reproduced covers two minutes in time near 0700 G.M.T. on July 5, 1935, and shows echoes, on a 6 mc./sec. frequency, which includes, in addition to the ground ray response and the known $E$-region echoes, a series of multiple reflections from the low heights now under discussion, together with echoes at intermediate heights which cannot, we suggest, be fitted into one or two simple series of multiple reflections.

This work has been undertaken as part of the programme of the Radio Research Board and this note is published by permission of the Department of Scientific and Industrial Research.

R. A. WATSON WATT.
L. H. BAINBRIDGE-BELL.
A. F. WILKINS.
E. G. BOWEN.

National Physical Laboratory,
Teddington, Middlesex.
May 14.

[1] *J. Inst. Elec. Eng.*, **78**, 10 (1936).

PROF. COLWELL and Mr. Friend[1] state that from results of experiments conducted by them they have been led to believe that, besides the usual *E* and *F* regions of the ionosphere, there is a third region—the *D* region—at a height of 5–55 km. They further say: "Such a layer has been postulated before as an absorption layer in the ozone region, but its reflecting powers have not been emphasised".

I would like to point out in this connexion that the formation, during daytime, of a region of ionisation much lower than, and distinct from, the usual Kennelly-Heaviside region has already been postulated by us, both from the consideration of the weakening and complete disappearance of *E*-echoes on the long wave-length side due to absorption by this region (as compared with that due to penetration on the short wave-length side) and from the evidence of echoes which have been detected by us from an equivalent height of about 55 km.[2,3]. These points, as well as the condition under which reflection may take place from such low heights, have been amplified and discussed by Mr. P. Syam, working under my direction[4]. The possible connexion of this ionised region with the ozonosphere—though this latter is now known to be at a height much lower than 55 km.—has also been mentioned. I may also add that Mr. J. N. Bhar, working in my laboratory at Calcutta, has recently reported having observed echoes from heights much below 55 km.

Prof. Colwell and Mr. Friend believe they have obtained echoes from well within the tropospheric regions. It is doubtful if such echoes, if they were observed, were due to the same mechanism as envisaged by the Eccles-Larmor theory. At such heights the collisional frequency is very high, and, for the wave frequency employed by these authors, an enormous electron concentration is necessary to bring down the effective dielectric constant to a zero value. Such high degree of ionisation, if it existed, could scarcely have been missed by those who carry out direct observations in these regions by aeroplanes or balloons.

It should be noted here that, according to English workers, the weakening of *E*-echoes, during daytime, is due to absorption in a non-deviating region (as distinguished from the deviating region of maximum electronic density at a higher level) of the Kennelly-Heaviside layer[5]. The ionised region postulated by us at a much lower height—which under suitable conditions reflects radio-waves—is distinct from this region. To avoid confusion I propose that this new region of ionisation be called the *C* region.

S. K. MITRA.

London.
May 9.

[1] R. C. Colwell and A. W. Friend, NATURE, **137**, 782 (1936).
[2] S. K. Mitra and P. Syam, NATURE, **135**, 953 (1935).
[3] S. K. Mitra, "Report on the Present State of our Knowledge of the Ionosphere", *Proc. Nat. Inst. Sci. India*, 1, 131 (1935).
[4] P. Syam, *Ind. J. Phys.*, **10**, 13 (1936).
[5] F. T. Farmer and J. A. Ratcliffe, *Proc. Roy. Soc.*, A, **151**, 370 (1935).

## Technique of the Painting Process in the Brihadesvara Temple at Tanjore

WHILE scientific investigations into the technique of the methods of production of the mural paintings in the Palace of Minos at Knossos, in Pompeii, etc., have been conducted by Noel Heaton[1], Eibner[2], Berger[3], Raehlmann[4] and others, very little has been done in this direction in the East. With the exception of the work on the Ajanta frescoes[5], of which, however, details of investigations are not available, nothing has been done to reconstruct the exact methods of production of ancient paintings in India, and compare them not only with the methods suggested in Indian texts on painting, but also with those adopted in the West in ancient times.

Recently, I had occasion to study the technique of the painting process adopted in the Brihadesvara temple at Tanjore in South India, in connexion with proposals for their conservation. Of the two groups of paintings in this temple, the earlier one is in the Ajanta or the 'classical' style of Indian art, and is important, since it is the only perfect specimen extant in India of the Hindu art of classical painting.

The paintings are executed on the walls of the dark passage surrounding the main shrine of the temple. The walls are built of large blocks of hornblende-gneiss and over them has been spread the lime plaster for the beautiful 'classical' paintings dating from about the twelfth century A.D., and belonging to the Chola period of Indian history. Over this, and completely covering it, is another loosely bound layer of paintings of about the seventeenth century A.D., which was executed during the days of the Nayaks of Tanjore. The latter group of paintings is cruder than the Chola group in technique and style and forms a type of 'folk' art.

The technique adopted in the execution of these paintings is fresco, no binding material having been used with the pigments. It represents a continuation of the older painting processes in India. From the different samples of painted stuccoes examined so far, the Chola paintings are in *fresco-buono* technique and the Nayak in *fresco-secco* technique. The stuccoes are almost alike in both these cases. They are composed of the *Rinzaffo*, a first rough coat of lime plaster, followed by the *Intonaco*, a second coat of fine lime plaster with pigments thereon. Their approximate thicknesses are given in the accompanying table:

Thicknesses of the Different Layers in the Stuccoes

| | Chola | Nayak |
|---|---|---|
| Entire stucco | 2·64 mm. | 2·35 mm.–3 mm. |
| Rinzaffo | 1·84 mm. | 1·52 mm.–2·17 mm. |
| Intonaco | 0·67 mm. | 0·63 mm. |

The results of analyses of the Chola and the Nayak stuccoes are as follows:

| | Chola stucco | | Nayak stucco | |
|---|---|---|---|---|
| | Rinzaffo | Intonaco | Rinzaffo | Intonaco |
| | Per cent | Per cent | Per cent | Per cent |
| Moisture | 0·38 | 0·23 | 3·14 | 3·77 |
| Silica, $SiO_2$ | 49·07 | 7·02 | 63·39 | 13·76 |
| Iron and Alumina, $Fe_2O_3 + Al_2O_3$ | 1·89 | 1·06 | 3·69 | 1·59 |
| Carbon Dioxide, $CO_2$ | 18·05 | 25·13 | 9·38 | 23·67 |
| Sulphuric anhydride, $SO_3$ | 0·26 | 0·58 | 0·17 | 0·59 |
| Magnesia, MgO | 0·51 | 0·37 | 0·33 | 1·02 |
| Lime, CaO | 27·88 | 65·59 | 18·56 | 55·68 |
| Undetermined (mostly alkalis) | 1·05 | *nil* | 1·34 | *nil* |
| | 99·99 | 99·98 | 100·00 | 99·98 |

Except sand, nothing has been used as an inert material along with the lime.

So far as the pigments are concerned, lime has been used for the white; carbon for black; red, yellow and brown ochres as red, yellow and brown pigments;

lapis lazuli or ultramarine for blue and terre verte for green. Such colours as yellowish green, light blue and bluish green have been got by mixing yellow and green or yellow and blue, blue and white and blue and green respectively.

Fuller details of the investigations will be published in a suitable journal.

S. PARAMASIVAN.

Chemical Laboratory,
Government Museum,
Madras.
March 5.

[1] Tiryns II, Die Ergebnisse der Ausgrabungen des Inst., Kaiserlich Deutsch. Arch. Inst. in Athen 1912, pp. 211-217. "Minoan Lime Plaster and Fresco Painting", *R.I.B.A. Journal*, 18, 697 (1911).

[2] "Entwicklung und Werkstoffe der Wandmalerei vom Altertum bis zur Neuzeit".

[3] "Die Maltechnik des Altertums".

[4] "Über die Maltechnik der Alten".

[5] Arch. Survey of India, Ann. Reports, 17, Part 1, 6-7 (1916).

## Raman Spectra of 'Heavy' Arsine, Silicichloroform and Silicibromoform

CONTINUING the study of pyramidal molecules, we have measured the Raman lines of light and heavy arsine. These substances were prepared in the usual way, by means of sodium arsenide and water. The measurements give:

| | $\omega_1$ | $\omega_2$ | $\omega_3$ |
|---|---|---|---|
| $AsH_3$ | 2094 | 990 | 910 |
| $AsD_3$ | 1508 | 730 | 630 |

$\omega_1$ and $\omega_2$ correspond to the single frequencies; $\omega_3$ to the double one.

We have also measured the Raman lines of heavy silicichloroform and silicibromoform; these are:

| | $\omega_1$ | $\omega_2$ | $\omega_3$ | $\omega_4$ | $\omega_5$ | $\omega_6$ |
|---|---|---|---|---|---|---|
| $DSiCl_3$ | 1647 | 252 | 489 | 555 | — | 179 |
| $DSiBr_3$ | 1616 | 167 | 360 | 468 | — | 114 |

$\omega_1$, $\omega_2$, $\omega_3$ correspond to the single frequencies, $\omega_4$, $\omega_5$, $\omega_6$ to the double ones.

Complete discussion of these results will be published elsewhere later.

J. M. DELFOSSE.

Physical Laboratory,
University, Louvain.

## Detection of Spotted Wilt Virus in Chrysanthemums

SPOTTED WILT of tomato, first recorded in Great Britain by K. M. Smith[1] in 1931, is now prevalent in the country, and is especially troublesome and difficult to control in gardens and 'mixed nurseries', where a variety of plants are grown, on account of the wide host range of the virus and the efficiency of its insect vector, *Thrips tabaci*. Control measures have to be directed towards the extermination of the insect vector and the destruction of infected plants, so that the detection of the virus in those perennial plants able to act as reservoirs from which the virus may be introduced into successive crops is often a matter of considerable importance.

Chrysanthemums are known to be susceptible to spotted wilt, and in several instances there has been strong circumstantial evidence that outbreaks of spotted wilt have originated from infected stocks of chrysanthemums. Unfortunately, the symptoms of spotted wilt in chrysanthemums, though at times well defined and recognised by characteristic ring and line patterns on the leaves, are usually rather indefinite and mild, and considerable difficulty has been experienced in detecting the virus in chrysanthemums, even in plants known to be infected. Observations and experiments made in the summer of 1935 and during the last few weeks have given a partial explanation of the failure to detect the virus of spotted wilt in chrysanthemums.

The addition of an extract of healthy chrysanthemum leaves to an extract of spotted wilt infected tomato leaves was found to inactivate the virus. For example, an extract of chrysanthemum leaves was prepared by grinding one part by weight of fresh leaves with two parts of distilled water and expressing the liquid through muslin. In the same way a preparation was made from spotted wilt infected tomato material, and divided into two portions. To one portion an equal volume of water was added, and of six tomato seedlings inoculated six developed symptoms of spotted wilt, and seventy-eight local lesions developed on four tobacco leaves inoculated, while no trace of infection resulted in similar numbers of tomato seedlings and tobacco leaves inoculated with the second portion to which an equal volume of chrysanthemum leaf extract had been added immediately before use.

Chrysanthemum leaf juice darkens rapidly on exposure to air, and it was thought that oxidising enzymes or the products of oxidation might be responsible for the inactivation of the virus. Bald and Samuel[2] showed that the virus of spotted wilt is sensitive to oxidising agents and that although certain reducing agents hasten inactivation, the activity of the virus in tomato juice is greatly prolonged in the presence of sodium sulphite. An extract of chrysanthemum leaves prepared with a 0·5 per cent solution of anhydrous sodium sulphite remains green for several days and does not immediately inactivate the virus when added to infected tomato juice. In one experiment the numbers of local lesions produced on eight tobacco leaves by portions of the same virus preparation diluted with equal parts of 0·5 per cent sulphite solution, sulphite chrysanthemum leaf extract and aqueous leaf extract were 152, 41 and 2 respectively.

A number of leaves were taken from a spotted wilt infected chrysanthemum and cut into halves longitudinally. One set of halves was ground up with 0·5 per cent sulphite solution, and sixteen lesions developed on the six tobacco leaves inoculated, while no lesions developed on the parallel series of leaves inoculated with the water extract prepared for the remainder of the material.

By this method it has been possible regularly to detect the virus in chrysanthemums from which previous attempts had been unsuccessful or inconclusive, and it is possible that the use of sodium sulphite might facilitate the detection of spotted wilt virus in other hosts or in plants in which the concentration of virus had fallen to a low level.

G. C. AINSWORTH.

Experimental and Research Station,
Cheshunt,
Herts.

[1] K. M. Smith, NATURE, 127, 852 (1931).

[2] J. G. Bald and G. Samuel, *Ann. Appl. Biol.*, 21, 179–90 (1934).

## A Case of Lethal Genes in the Horse

THE only case of a lethal gene in the horse described hitherto was by Yamane[1] in Japan; it produced a blind large intestine, which caused colic and death among the new-born foals sired by one Percheron stallion. The following case, which I have observed in the well-known Polish stud of half-breed horses at Skrzydlów, p- Aurelów, near Częstochowa, is therefore of interest, because its explanation is analogous to that of Yamane's case mentioned above, although perhaps more complicated.

The Anglo-Arab stallion Menzin (Polish St. B. V. I., p. 204) covered in 1933 seventeen mares; in 1934, nine foals sired by Menzin were born, of which six were quite normal and three showed a peculiar lameness of one or both forelegs. The new-born foals could not stand at all and, of course, it was necessary to destroy them. In the following year (1935) thirteen foals were sired by Menzin: of these nine were normal and four were cripples. In neighbouring stud-farms, where Menzin also covered some mares, four foals sired by him were born; three were normal and one cripple.

It should be stated that, before 1934, when the mares at Skrzydlów were served by other stallions, they never produced cripples.

The legs of the crippled foals were examined and no signs of rickets or any other bone disease have been found. The lameness consisted in a marked bending of the leg in the region of the phalanges, with an undeveloped hoof. Somewhat analogous with this is the case of inherited crooked fingers in new-born children described by Mohr[2].

A detailed report in a genetical journal will follow.

R. T. PRAWOCHENSKI.

Zootechnical Laboratory,
Jagellonian University, Cracow.

[1] "Biological Essays on the Horse", 1929, p. 39. Berlin.
[2] "Über Lethalfaktoren", *Z. ind. Abst. u. Ver. Lehre*, 1926.

## Mutations arising at the Bar Locus in *Drosophila melanogaster*

THE Bar mutation has been investigated by Sturtevant (1925–26), Dobzhansky (1928) and others. However, so far two very important lines of inquiry have remained obscure in the Bar problem: (1) What is the cause of the occurrence of Bar mutation *de novo*; and (2) what is the nature of Bar mutations caused by irradiation with X-rays?

Hanson (1928) has shown that Bar mutations arise in males exposed to X-rays. By exposing males to X-rays we obtained a great number of Bar mutations (1 : 382); for example, complete reverse mutations, feebler and stronger allelomorphs of Bar, some of which were lethal, others sterile. A cytogenetic study of the salivary nuclei has shown that out of thirty-four cases studied, in seventeen the occurrence of the Bar mutation was connected with an aberration. In ten of these cases one break occurred exactly at the Bar locus (Fig. 1); in six cases, some distance from Bar; and in one case there was a deficiency which included the Bar locus. It is noteworthy that among the complete reverse mutations studied, only one aberration among ten was connected with a break at a distance from Bar; whereas in the seven cases of incomplete reverse mutations (infra-Bar and ultra-Bar types), five breaks occurred some distance from Bar.

In the majority of cases the complete reverse Bar mutations are not connected with a loss of this locus. They are not manifested phenotypically, however, when they are heterozygous for Bar, appearing as homozygous Bar. On the other hand, the reverse mutations retained completely the mutational potentialities of Bar. When reverse mutations were exposed to X-rays a great number of Bar mutations were obtained (1 : 928) which were all connected with chromosome aberrations. The eight cases studied cytologically were all connected with a break of the $X$-chromosome at Bar.


FIG. 1. Case of mutation of the Bar gene connected with aberration at the Bar locus (inversion).

The X-irradiation of double Bar showed unexpectedly a lower frequency of Bar mutations and a disproportionately frequent simultaneous mutation of both Bar genes, producing an allelomorph without phenotypic manifestation (double reverse Bar but not deficiency as Demerec thought). Finally, it was shown that half of these mutations occur in connexion with chromosome aberrations—of fourteen cases six were without aberrations and eight were connected with breaks at the Bar locus.


FIG. 2. A region of the $X$-chromosome from the nucleus of a salivary gland cell of a heterozygous fly (double-Bar $X$ Normal). The insertion of double Bar is detectable in region 16 A.

Taking into account Sturtevant's investigations and Wright's considerations, we investigated Bar cytologically. In the females heterozygous for Bar, an insignificant non-coincidence of chromosomes at the Bar locus was found. A study of the heterozygotes for double Bar (E. N. Volotov) has shown the presence of insertions at the Bar locus (Fig. 2). Consequently, all the known occurrences of Bar mutations *de novo* are connected with disturbances of the chromosomes at the Bar locus (the case of Tice which was studied cytologically by us, baroid of Dobzhansky, the two Bar mutations of Muller, and one Bar mutation discovered by Dubinin and Goldat, unpublished).

The mutational changes of the Bar gene induced by X-rays are in many instances caused by the effect of the position of this gene on its manifestation.

The Bar mutations occurring *de novo* are also caused by the effect of the position of the genes at the Bar locus (see also Dobzhansky, 1932).

A study of the occurrence of Bar mutations under the action of X-rays shows that the breaks at the Bar locus occur more frequently than Bar mutations *de novo* (if the greater frequency of breaks in the Bar chromosome are not caused by the presence of the Bar gene itself). Hence, for the occurrence of Bar *de novo* not only a break of the chromosome at the Bar locus is necessary but also an attachment of some other specific material as well.

A comparison of the mutational process in Bar and double Bar leads us to suspect that the position effect changes the action of the gene as well as its mutational potentialities.

N. P. DUBININ.
E. N. VOLOTOV.

Institute of Experimental Biology,
Moscow.

## Cosmic Rays and Mutations

THE following results have a bearing on the problem touched upon by Dr. Hamshaw Thomas in his paper "Cosmic Rays and the Origin of Species"[1].

In 1933 I had the idea of subjecting *Drosophila* flies to the action of cosmic rays in the stratosphere. However, it was only in 1935 that I was enabled to carry out my plan, and about 300 *Drosophila melanogaster* males were entrusted to the crew which made an ascent from Moscow on June 26 in the stratostat *U.S.S.R.-I-bis*. The crew of the balloon consisted of K. J. Zille, J. G. Prilutzky and Prof. A. B. Verigo. This experiment was carried out with the view of demonstrating the possible effect of cosmic rays on the mutation process. The experimental flies were placed in the gondola where an average temperature of 12°–14° C. was maintained. The ascent lasted from 5.25 a.m. until 8.2 a.m., the balloon attaining an altitude of 15,900 metres.

According to the data of Prof. Verigo, the experimental flies were for two hours under the action of cosmic radiation which in intensity exceeds cosmic radiation at the level of the ground on the average by 100 times. As soon as the flies landed safely they were studied genetically. The usual *ClB*-method for determining the lethal mutation which occurs in the *X-chromosome of the sperm of initial males* was adopted. At the same time we kept a control batch of flies of the same age and stock (counting 20 days from the egg stage, a wild stock of Nalchik, inbred for five generations).

The following results were obtained: in 2,724 chromosomes of the experimental flies, 8 mutations were obtained ($0 \cdot 294 \pm 0 \cdot 104$ per cent), whereas 2,445 chromosomes of the controls gave 10 mutations ($0 \cdot 409 \pm 0 \cdot 129$ per cent).

These negative results compel us to be circumspect in accepting theories which look upon cosmic rays as important factors in organic evolution.

HEINRICH FRIESEN.
Institute of Experimental Biology,
Moscow.

[1] NATURE, 137, 51 (1936).

## Photochemical Reaction of Chlorophyll with Ferrous Ions

A SHORT time ago, J. Weiss[1] described in NATURE some experiments on the photochemical bleaching of dyestuffs *in presence of ferrous ions, and interpreted* the bleaching effects as reduction-oxidation reactions between the excited dyestuff molecules and the ferrous ion, according to the equation

$$Fe^{++}HOH + (D_s h\nu) = Fe^{+++} + OH^- + (D_s\text{-}H) \quad (1)$$

As dyestuffs he used brilliant-cresylblue, methylene-blue, thionine, uranine and chlorophyll.

I should like to point out some difficulties encountered if one tries to reproduce Weiss's experiments using chlorophyll as the photochemically active dyestuff.

Ferrous sulphate, it is true, exerts a bleaching action on chlorophyll, both in neutral and sulphuric acid solution, but this reaction is *not* influenced by irradiation. It is easy to prove this by adding a small quantity of solution of ferrous sulphate to a solution of chlorophyll in methyl alcohol and irradiating with a strong carbon arc after thoroughly removing the atmospheric oxygen (say by evacuating the vessel for a sufficiently long time). The irradiation causes *no change* of colour. The experiment gives the same result also when sulphuric acid is added[2]. But if atmospheric oxygen is not, or not thoroughly, removed, a rapid bleaching of the chlorophyll may be observed, and the solution takes an olive brown coloration, indicating that an oxidation product of chlorophyll has been formed[3].

It may be inferred from this evidence that the photochemical reaction between chlorophyll and ferrous sulphate does not take place according to the equation (1), and that it is not analogous to the photochemical reduction of the vat dyes. In view of the fact that this reaction takes place only in presence of oxygen, it may rather be regarded as a photochemical oxygen transfer, the ferrous sulphate acting as an acceptor. In this sense that reaction is in close analogy to the photochemical bleaching of chlorophyll in presence of thiosinamine and other organic acceptors[4]. Photochemical reactions of this description take place also in the absence of acceptors, for example, in absence of ferrous sulphate, but with an incomparably smaller velocity. Further results on the photochemical oxidation of chlorophyll will be published elsewhere.

With respect to Weiss's experiments with the other dyes referred to in his note, I described more than four years ago identical experiments on the bleaching of thionine in presence of ferrous sulphate and sulphuric acid[5]. The photochemical reaction between methylene blue and ferrous sulphate has been studied, moreover, by K. M. Brandt[6].

K. WEBER.
Physico-chemical Institute,
Engineering Faculty,
University, Zagreb, Yugoslavia.
March 16.

[1] J. Weiss, NATURE, 136, 794 (1935).
[2] According to Willstätter and Stoll ("Assimilationsbuch", p. 226), chlorophyll is, moreover, destroyed by addition of acid.
[3] Cf. Willstätter and Stoll, l.c., p. 415.
[4] Cf. H. Gaffron and K. Wohl, *Naturwiss.*, **24**, 103 (1936).
[5] K. Weber, *Z. phys. Chem.*, B, **15**, 38 (1931); *Naturwiss.*, **23**, 849 (1935).
[6] K. M. Brandt, *Arkiv för Kemi*, **12**, No. 7 (1935).

## Thermal Decomposition of Ethylene Oxide

THE thermal decomposition of ethylene oxide vapour was first studied by Heckert and Mack[1], who showed that the process has the essential characteristics of a kinetically unimolecular reaction. In many respects, however, their data were incomplete and the interpretations suggested rather unsatisfactory. We have recently made a detailed re-examination of the kinetics of the reaction. In view of recent discussion of the problem by several workers[2], it may be desirable to summarise now the results of our investigation, which although in general agreement with that of Heckert and Mack, is more complete.

We have measured the rate of the decomposition over the temperature range 435°–505° C.; that is, up to temperatures 70° C. higher than those used by Heckert and Mack, where the rate was very small. The use of the higher temperatures has both experimental and theoretical advantages. The products are predominantly carbon monoxide and methane, but hydrogen and ethane are also formed. The reaction is roughly 'first order over its course', but the velocity constant is noticeably dependent upon pressure, as found by Heckert and Mack.

A careful examination, however, of the manner in which the velocity constant varies with pressure over the range 15–800 mm. reveals the existence of a 'segmented' plot of $1/t_{1/2}$ against $p_0$. At 475° C. the 'period of half change' is almost independent of initial pressure with $p_0 > 250$ mm. Between c. 250 mm. and 40 mm. there is a 'bimolecular' relationship between $t_{1/2}$ and $p_0$, and below c. 40 mm. at least one other such 'bimolecular' region. In this respect, therefore, the reaction falls into line with other similar decompositions recently examined[3], and can be interpreted as involving the superposition of several independent quasi-unimolecular processes. The energy of activation of the reaction for $p_0 > 300$ mm. is c. 54,000 cal., and at the lowest pressures (c. 20 mm.) is somewhat lower (c. 50,000 cal.). The rate at the pressure at which the 'falling-off' is first manifest is in accordance with the postulation of a distribution of activation energy among about nine squared terms, which appears a more reasonable value than that previously calculated by Ramsperger[4].

Increase in the surface-volume ratio of the reaction vessel by about eight times at 470° C. lowers the rate by less than 10 per cent, which, allowing for possible errors, is scarcely significant. The existence of appreciably long reaction chains is therefore unlikely. It has been suggested that isomerisation to acetaldehyde is the first stage in this decomposition, even though no direct evidence for such a mechanism was obtainable. We have been unable to detect the presence of acetaldehyde among the reaction products at any stage of the decomposition over the temperature range employed.

Inert gases (argon, nitrogen, helium and others) retard the decomposition to some extent, but the precise details of this effect require a fuller explanation.

The detailed results will shortly be published elsewhere.

H. W. THOMPSON.
M. MEISSNER.

Old Chemistry Department,
Oxford.
April 2.

[1] *J. Amer. Chem. Soc.*, **51**, 2706 (1929).
[2] NATURE, **136**, 909 (1935); *J. Amer. Chem. Soc.*, **58**, 534 (1936).
[3] *Proc. Roy. Soc.*, A, **141**, 41 (1933); A, **146**, 327 (1934).
[4] *Chem. Rev.*, **10**, 27 (1932).

## Antagonistic Effect of Iodides in Baldness and Toxicity due to Thallium Acetate

IN earlier reports[1,2], we stated that potassium iodide administered subcutaneously prevents the loss of hair caused by thallium acetate, as well as reduces considerably the toxicity of the latter.

The object of the present investigation was to find out whether other salts of iodine have the same effect as potassium iodide. We used seven groups of rats, each group consisting of seven rats, except the sixth thallium group which had ten rats. The experiment continued for 69 days. The first four groups ($A$) were receiving daily *per os* for a period of 32 days 0·3 mgm. and for a further 36 days 0·4 mgm. of thallium acetate per 100 gm. weight. In addition, the animals of these four groups received daily subcutaneously 0·5 c.c. of lithium iodide, potassium iodide, sodium iodide and magnesium iodide, respectively (1 c.c. of iodide solution contained 20 mgm. of iodine). The animals of the fifth group ($A_5$), which were receiving daily the same quantity of thallium acetate *per os* as the previous four groups and also 0·5 c.c. of calcium iodide, very quickly developed dermatitis of the third grade due to the amount of calcium ion administered, and therefore we had to discontinue the calcium iodide. The animals of the sixth group ($B$), which served as controls to the five $A$ groups, received *per os* thallium acetate only in the same quantity as the $A$ groups. However, during the experiment the animals of Group $B$ looked very ill, and in order to save some animals to the end of the experiment we had twice for two days to discontinue the administration of thallium acetate (six out of ten died). The animals of the seventh group ($C$), which served as controls, received no chemicals.

At the end of the experiment, all the animals of the first four groups ($A$) looked healthy, they had increased in weight on the average from 38 gm. to 135 gm. (two rats of the sodium group and one of the magnesium group died during the experiment) and preserved almost completely their coats; however, their hair was softer and lacked the lustre of normal hair. Also the two survivors of Group $A_5$, which received later on potassium iodide instead of calcium iodide, had the same appearance as the animals of the other $A$ groups.

The surviving animals of Group $B$ lost their hair almost completely; in a few places the lanugo was seen, and also the feelers were not affected. These animals developed stomatitis, erythema and eczema and at the end of the experiment they looked very poor. The most striking effect of thallium acetate was that all the survivors of this group developed cataracts and other eye defects after 35–50 days of administration of thallium acetate, and the animals became entirely blind. This was never observed in the rats of the $A$ groups. Also their average weight showed a smaller increase (from 38 gm. to 115 gm.) and was below the weights of the animals which received the iodides.

The rats of Group $C$ increased in weight on the average from 36 gm. to 195 gm. and looked entirely normal.

The results of this experiment indicate that lithium iodide, potassium iodide, sodium iodide and magnesium iodide prevent to a great extent the falling out of hair, reduce considerably the toxicity of thallium acetate and prevent the development of cataracts and other eye defects brought about by thallium acetate. The best results were obtained with lithium and potassium iodide; the results with sodium and magnesium iodide were a little less satisfactory. Calcium iodide would probably have the same biological action as the other iodides used in this experiment, but due to its deleterious effect upon the skin it cannot be used subcutaneously in such experiments.

These results are not in accordance with the results of some scientific workers[3], who state that potassium iodide does not act as an antidote to thallium (probably not in acute thallium poisoning); in our experiment we obtained satisfactory results with potassium and other iodides as antidotes in chronic thallium poisoning.

O. V. HYKEŠ.
F. A. DIAKOV.

Department of General
Biology and Parasitology,
Veterinary College,
Brno, Czechoslovakia.
April 2.

[1] Hykeš and Diakov, NATURE, **136**, 685 (1935).
[2] Hykeš and Diakov, *Publications biol. École vétérin. (Biol. spisy V. š. zvěrolék.) Brno*, **14**, 85 (1935).
[3] Hesse, "Handb. exper. Pharmakol.", iii, Bd. 3, T., 2177 (1934).

## The Harding Sugar Reagent

THE Harding[1,2] sugar reagent has recently been criticised by Van der Plank[3], who failed to reproduce Harding and Downs'[2] factor for glucose.

In our experience this is one of the most sensitive of the copper reagents and one of the most accurate if prepared from pure chemicals. We have easily and constantly reproduced the factors published by Harding and Downs with many different batches of reagent, and have found the factor for glucose not to vary from day to day over periods up to twelve months. It was found, however, that if chemicals of a grade inferior to AnalaR be used, inconsistent results may be obtained. For example, the use of ordinary quality anhydrous sodium carbonate resulted in an inferior reagent: the defect was at once remedied when anhydrous sodium carbonate of 'analytical' quality such as Shering-Kahlbaum's was used. We would suggest that Van der Plank's findings may be due to a similar cause.

E. J. KING.
G. A. D. HASLEWOOD.
British Postgraduate Medical School.
G. A. GRANT.
Lister Institute.
April 17.

[1] *Trans. Roy. Soc. Can.*, Section v, **26**, 33 (1932).
[2] *J. Biol. Chem.*, **101**, 487 (1933).
[3] *Biochem. J.*, **30**, 458 (1936).

## Ascorbic Acid as a Precursor of Serum Complement

MY experiences (unpublished) are in complete accord with those of Dr. F. Marsh[1].

Some years ago, when working in the Bacteriological Department, Trinity College, Dublin, I was responsible for carrying out weekly routine Wasserman reactions. During the winter months, I had found on several occasions that the serum of guinea pigs was very deficient in complement, and that most of the animals died after bleeding by intra-cardiac puncture. On one occasion the deficiency in complement appeared to be the prelude to an epidemic of pneumonia which swept off most of the stock.

On inquiry, I found that the animals had been receiving neither grass nor other fresh food, and on the addition of mangolds or cabbage to their diet the complement rapidly (within the course of the next week) rose to normal titres. It was interesting also to note that animals with a fresh diet rarely died from the effects of intra-cardiac puncture.

Owing to pressure of routine work, it was unfortunately not possible to carry out a quantitative investigation on this subject.

E. S. HORGAN.
Stack Medical Research Laboratories,
Khartoum.
April 21.

[1] NATURE, **137**, 618 (April 11, 1936).

## Points from Foregoing Letters

AN arrangement for detecting induced radioactivity of short periods (greater than 0·3 sec.) is described by Dr. T. Bjerge. He finds in beryllium, after neutron bombardment, a strong activity of half-period 0·9 sec. and maximum energy of the order 6–8 × 10[6] electron volts.

From the angular distribution of scattering of the slower alpha particles by light and heavy hydrogen and by helium, C. B. O. Mohr and G. E. Pringle calculate that the forces which come into play would be active at distances greater than $10 \times 10^{-13}$ cm. They conclude that, if the current method of explanation is to be retained, forces of range longer than $e^2/mc^2$ must also be included.

Three distinct electrical conducting regions in the middle atmosphere (6–60 km. high) from which radio waves up to very high frequencies are returned are described by R. A. Watson Watt, L. H. Bainbridge-Bell, A. F. Wilkins and E. G. Bowen. The lowest is usually at about 6 km. but sometimes at 10 km. and even at 14 km. The second region is at 15–45 km. and appears to be related to local thunderstorms. The third region is about 60 km. high. The existence of an electrically conducting region at a height of 5–55 km. was shown recently by Colwell and Friend; they proposed to call it the *D* region. Prof. S. K. Mitra directs attention to previous work by himself and his co-workers which indicated a conducting region at a height of 55 km., and states that recently Mr. J. N. Barr has observed echoes from heights much below 55 km. Prof. Mitra suggests calling the new region the *C* region.

G. C. Ainsworth reports that the addition of 0·5 per cent sodium sulphite to an extract of chrysanthemum leaf containing spotted wilt virus renders easier the detection of the virus (by inoculating tobacco leaves). Without the addition of sulphite the test is frequently inconclusive; this is due apparently to inactivation of the virus by oxidising enzymes or oxidation products present in chrysanthemum juice.

The cause and occurrence of reduction in the number of ocelli in the compound eye of the fruit fly under the influence of X-rays, and the related chromosome change, are discussed by Prof. N. P. Dubinin and E. N. Volotov. They report that new mutations of this type are connected not only with a break of the chromosome in the Bar region but apparently also with the attachment of some other specific material, since the number of mutations observed is smaller than that of the breaks, and other aberrations were also noticed.

An experiment on the possible effect of cosmic rays in producing lethal mutations in the *X*-chromosome of the fruit-fly is reported by Prof. H. Friesen. The flies were taken on the stratosphere flight of the *U.S.S.R.-1-bis*, and were subjected for two hours to a hundredfold greater intensity of cosmic radiation than control flies left behind. The result was negative.

The mechanism of the thermal decomposition of ethylene oxide vapour has been a recent subject of discussion. A more detailed study of the kinetics than formerly has now been made by Dr. H. W. Thompson and M. Meissner, who are of opinion that the process is of the same general type as the decomposition of acetaldehyde and other related substances, and involves the simultaneous occurrence of several quasi-unimolecular reactions.

Further experiments on rats showing that not only potassium iodide but also the iodides of sodium, lithium and magnesium, counteract to a great extent the chronic toxic effects (such as baldness) due to thallium acetate are reported by Prof. O. V. Hykeš and F. A. Diakov. It appears, however, that iodides are valueless as antidotes in acute thallium poisoning.

# Research Items

### A Second Neanderthal Man from Italy

THE discovery on July 16, 1935, of a Neanderthal skull, only the second to be found in Italy, in the quarry of Saccopastore, near Rome, is described by the Abbé Breuil and A. C. Blanc, the finders, in *L'Anthropologie*, **46**, Nos. 1–2. It was also in this quarry that the first Neanderthal skull was found in 1929. The quarry is part of a low river valley terrace, and has been abandoned for some years. Water has accumulated in the centre, and makes the sections difficult of access. The new skull was found in the north section. The stratification is complicated. The deposits evidently belong to two complexes, of which one is much older than the other. The two are separated by a period of erosion of marked intensity. The skull was found in the upper part of Stratum *F*, a deposit of fine sand belonging to the older complex, showing no stratification, and homogeneous. It was, however, also partly in the lower deposits of Stratum *E*, consisting of fine gravel mixed with sand. Although at present freed only in part from deposit, the skull can be seen to have the dentition of the right side complete, while the face on this side, almost intact, is high, with little prognathism and shows no trace of the canine fossa. The orbital cavity is large and rounded, as is also the nasal aperture. Two flint flakes were found *in situ*, one in immediate contact with the skull being subtriangular and pointed, measuring 25 mm. by 13 mm., while the other, found some metres to the east at the base of Stratum *E*, is a small irregular flake of calcedony, 40 mm. by 16 mm., and showing no retouch. A third, a flake of calcedony of unknown provenance, was found near the entrance of the quarry. The distal part of a broken tibia of *Bos* has a transverse fracture at its distal end caused by an intentional blow. The evidence of malacological fauna and molluscs, examined by Mr. A. S. Kennard, and the geological evidence, concur in ascribing the deposits in which the skull was found to a period of a cold dry steppe climate preceding the oncoming of Würm I.

### Primitive Medicine in Malabar

MR. A. AIYAPPAN describes in *Man* of April the growth of a cult in the Cochin State of Southern India and its function among the populace as a means of curing a number of ailments. The shrine is situated near the Mullūrkara railway station, where a flat-topped hillock surmounted by a huge dolmen has on one side a vertical wall of granite, in which is a niche about 10 ft. high, with a spirited figure of Siva as *Dakshināmūrti* sculptured on it. The figure is in an unusual pose, turning away from two students at its feet. It has been attributed to the period between the sixth and eighth centuries. It was discovered accidentally by slaves, who were clearing vegetation. It was afterwards worshipped, first by low caste men and then by higher castes. Although it is in the possession of the Nayars, it is still used by all castes, including the unapproachable castes, who are allowed to make their offerings in person without the intervention of a priest. The reason for this variation from custom is thought to be that low castes began the cult. The people have discovered that *Dakshināmūrti* could be successfully invoked for driving away pestering spirits. To the unsophisticated Hindu, his deity and temple are more hope-giving than a hospital; and here the largest number of offerings are for curative purposes. Figures of an affected limb are offered in wood, stone or pottery, or when the disease is more general effigies of the whole body. Similar figures of live-stock are offered when they are ill. Cradles are offered for getting children, and figures of breasts by young women whose own breasts are under-developed. Figures of animal pests, such as rats, boars, etc., are used to secure protection from them. A wooden tortoise is said to have been a cure for stomach-ache. All offerings are placed before the deity for a short time and then heaped up by the side of the temple.

### Viscera of Primates

STRAUSS (*Proc. Amer. Phil. Soc.*, **76**, No. 1; 1936) has dissected fully the viscera of three specimens of orang-utan, an old male with an anterior trunk height of 49·8 cm., a juvenile male and a new-born female. He has utilised the information thus obtained to preface a comparative account of the viscera of primates in general. It is found that the four anthropoids and man exhibit a group of characters in common that indicate their affinities and close genetic relationship. These include the high and partially transverse disposition of the heart, the reduction of lobation of the lungs, the restriction of the pleural sacs and their sternal dissociation, a true vermiform appendix, a sigmoid colon, the completion of an ascending mesocolon, the development of a secondary jejuno-ileal mesentery and the reduction (save in the gorilla) of hepatic lobulation. All of them offer a curious mixture of primitive and specialised characters, but there appears from the parts under review no reason for supposing man to be more closely related to the chimpanzee or even to the chimpanzee-gorilla stock than to the other primates.

### Antarctic Foraminifera

MR. ARTHUR EARLAND has now published Part 3 of the Foraminifera ("Discovery" Reports, **10**, pp. 1–208. Cambridge: University Press, 1935. 37*s*. 6*d*. net). This embraces the Falkland Sector of the antarctic (excluding South Georgia), the first part having dealt with the bottom deposits of the Falkland Islands and adjacent seas, an area outside the extreme limit of the pack-ice, with a characteristic sub-antarctic fauna; the second part with the deposits of South Georgia, which lies within the antarctic regions although very nearly in the same latitude as the Falkland Islands. The present report deals with a large area farther south, extending over nearly 90° of west longitude, or practically a quarter of the south polar circumference. This is a very interesting contribution to our knowledge of the distribution of the group. It is a question whether the deep sea was populated by migration from cold polar waters, or whether the antarctic fauna had its origin in the deep sea. The author is inclined to the view that the antarctic fauna originated in migration principally from the deep water of the adjacent

oceans, and that the invasion is still in active progress. He believes that, with the exception of a few species which appear to have a circumpolar distribution and are not found in the deep sea of warmer latitudes, the present antarctic fauna represents the successful attempt at the colonisation of a fresh area. There are not many genera and species, and these are chiefly primitive forms, principally belonging to the Arenacea; conditions of life not having favoured the hyaline and porcellanous forms to any great extent. Certain species of Pacific origin were found in these regions which had no previous antarctic history yet were known from Australia and New Zealand areas. This is specially the case with the genus *Lagena*, but there are also other forms which show an extension of the range of species in an eastern direction across the South Pacific. A few species appear to have a complete circumpolar distribution, and are not known outside the Antarctic.

### Mallophaga or Bird-Lice from the Tinamous

M. A. CARRICKER, jun., has recently published an extensive paper on the above subject (*Proc. Acad. Nat. Sci. Philadelphia*, **88**, 45–218; 1936). Next to the struthious birds, the tinamous represent the oldest living family of birds. Their mallophagous parasites form the most extraordinary group of these lice of which we have any knowledge. The generic differences and extremes are very remarkable and can only be explained on the basis of the great antiquity of the host family. The great majority of the Mallophaga found on tinamous belong to a group of genera which constitute a new family—the Heptapsogastridæ, the chief character of which is the reduction of the abdominal segments to seven in number. This feature is brought about either by the complete loss of the first segment or by the fusion of the first and second segments. The author remarks that the tinamous possess the most diversified and bizarre collection of genera and species of Mallophaga, while the family, as a whole, will undoubtedly take first rank in the number of genera and species found on a single host species and individual.

### An Amphidiploid Wheat

AN interesting new wheat hybrid is described by Dr. D. Kostoff (*C.R. Acad. Sci. U.S.S.R.*, 1, No. 1) between the tetraploid *Triticum Timopheevi* with 28 chromosomes and the diploid *T. monococcum* with 14. The $F_1$ hybrids were all sterile, but in a head which had been crossed with the pollen of an $F_4$ segregate from the triple hybrid, *T. turgidum* × *T. dicoccum* × *T. vulgare*, a single large grain was obtained. The plant raised from it had 42 chromosomes, and the evidence indicates that it was an amphidiploid produced by the parthenogenetic development of an egg of the *Timopheevi-monococcum* hybrid which had failed to undergo meiosis. This amphidiploid is intermediate between the two parent species, both of which, as well as the $F_1$ hybrid, were immune to rust and mildew. The amphidiploids are highly fertile, with spikes like the $F_1$ in glume and awn characters but, as is to be expected, the cells are larger. This new hexaploid wheat (called *T. Timococcum*) is regarded as a very promising form to cross with *T. vulgare*, and thus introduce immunity into the bread wheats. It is possible, however, that immunity may be determined, at least in part, by cell size, the diploid and tetraploid species being more immune because of their smaller cells.

### Meteorology in Great Britain

THE latest volume of the "Weekly Weather Report" of the Meteorological Office, Air Ministry, which is now published only as an annual volume, is the fifty-seventh of the series. It covers the period March 4, 1934–March 2, 1935. The report is in the form that was first adopted for the volume giving data for 1929, according to which the information is partly expressed as weekly averages of the different meteorological elements regarded as of most importance for agriculture—temperature, accumulated temperature, rainfall and bright sunshine—and partly as deviations of these elements from their 'normals' or long period averages. There are fifty-seven well distributed stations to represent the British Isles, the stations being the same as those employed in the preceding volume. A table of normal weekly values for the twelve districts into which the British Isles are divided, based on the records of the standard 35-year period 1881–1915, is followed by another giving weekly departures for each district from the corresponding district normal, for the period under review, and these weekly deviations from normal are averaged for the four seasons and for the year. The character of the year in any district can be ascertained by a glance at this table. Then follow the weekly data for each individual station, one station filling one page, an arrangement which similarly presents the main features of the year, but for a particular place, in a very compact form. It can, for example, be seen with little trouble that in London (Kew Observatory) temperature in the whole year ranged from 27° to 84° and was nearly two degrees above the average; that rainfall was distinctly below and sunshine distinctly above the average in spite of the very wet and dull winter, notably sunny periods being enjoyed in July and again during the last part of August and the early part of September. The column of figures representing the departure from normal of temperature shows that there was only one week which was so much as 5° below the normal—that beginning on Oct. 28, with an average of 42°; that in the week beginning on Dec. 2 temperature averaged the remarkably high figure of 52·4°, an excess of nearly 11° above normal; that, moreover, the cold week was preceded by twenty out of which only one was cold.

### An Optical Model for Studying the Acoustics of Theatres

THE acoustic characteristics of a hall or theatre are almost completely determined by the reflection of the sound waves at the walls. The sound audible to the audience is caused by several factors. There are first the 'direct sound' waves; secondly, the 'useful sound' which, in addition to the direct sound, includes every sound wave striking the ear within 1/15 of a second after the arrival of the direct sound; thirdly, 'reverberation' which includes the useful sound and all the contributed sound waves which reach the ear after 1/15 of a second; and finally 'echoes'. An echo is a reflected sound wave which owing to the peculiar shape of part of the reflecting walls predominates over the reverberation by means of its high intensity. The reverberation period is defined as the time taken by the intensity of the sound to decay to the millionth part of its initial intensity. In the case of musical productions and the spoken word, definite reverberation periods give optimum results. In the ideal theatre, the whole sound radiated from the source would reach the audience

as useful sound. Unless the speaker is surrounded by a sound reflector, this acoustic ideal cannot be even approximately realised. In *Philips Technical Review* of February, there is a description of an optical model which was used to perfect the acoustics of the Philips theatre at Eindhoven. The model of the hall is made of sheet aluminium, and a small movable lamp is used as a 'sound-source'. About 50 per cent of the light is reflected from the walls, so that after three reflections the initial intensity of the light is reduced to about ten per cent. The luminous intensity at each point on the model is therefore determined by the interaction of only a few reflected rays and so the resultant luminous intensity is an approximate measure of the useful sound intensity. The model showed at once that the greatest part of the audible sound came from the roof. This proves that in an open air theatre the spoken sound is much less audible. Further experiments with another model enabled completely satisfactory results to be obtained.

### High-Frequency Electric Melting Furnace Equipment

IN the *G.E.C. Journal* of May a description is given of a high-frequency electric melting furnace equipment recently installed in the Novo Steel Works at Sheffield. When the works were first founded in 1870, the whole of the steel produced was made from wrought iron by the cementation process followed by forging. Since then, the equipment has been continuously altered as the demands made for complete heat treatment, especially the treatment required for the high-class steels used for aircraft and motor-cars, have increased. The conditions required for their manufacture in the casting shop are now comparable for those associated with laboratory methods so far as precision, control and cleanliness are concerned. Analysis shows that the steel made in the high-frequency furnace on a commercial basis is of exceptional purity and uniformity. Stainless and other steels which contain high percentages of chromium, tungsten, molybdenum and other alloying additions are made without appreciable loss of these constituents and without carbon increment or the picking up of sulphur or other deleterious elements. It has been proved that if more than one ingot is poured from one melt, each ingot and every part of each ingot gives practically the same analysis. This is due to the well-known stirring effect caused by convection currents within the molten charge, a phenomenon inherent and peculiar to the high-frequency furnace. So far as the workmen are concerned, the working conditions are greatly improved, as it is comparatively cool and comfortable in the neighbourhood of the furnace. The capacity of the larger of the two furnaces described is half a ton.

### Carbohydrate Metabolism

A USEFUL review, by Prof. O. Meyerhof, of recent work on carbohydrate metabolism is published (in German) as a supplement to the March 1936 issue of *Current Science* (4, 669–682). The author confines himself chiefly to a discussion of experiments carried out in collaboration with K. Lohmann and W. Kiessling, in which the cause of alcoholic fermentation and the formation of lactic acid by enzymatic breakdown of carbohydrates were studied. As a result of these researches, the author formulates schemes for the series of changes occurring in both processes, which represent a further advance in our knowledge of carbohydrate metabolism (see NATURE, 132, 337 and 373; 1933). The scheme for lactic acid formation is more detailed than that of Embden, from which also it differs at several points: thus in the initial reaction adenylpyrophosphate reacts with hexose to form hexosediphosphate and adenylic acid: the diphosphate is then converted into α-glycerophosphate and phosphoglyceric acid via dioxyacetone phosphate: Embden suggested that the intermediate stage was glyceraldehydephosphoric acid with dioxyacetonephosphoric acid. The phosphoglyceric acid is then converted to phosphopyruvic acid, which reacts with hexose to form hexosediphosphate and pyruvic acid. The latter reacts with more hexose and phosphate to form triosephosphate, which with pyruvic acid is converted to phosphoglyceric acid again and lactic acid: in Embden's scheme the process is simpler, the phosphoglyceric acid being converted to pyruvic acid and phosphoric acid, the former reacting then with α-glycerophosphoric acid to form triosephosphate and lactic acid. The paper is illustrated with curves describing the experiments from which Meyerhof has been led to suggest his modified schemes for both fermentation and formation of lactic acid.

### Constitution of Acacipetalin, a New Type of Glucoside

DR. CLAUDE RIMINGTON has recently described the isolation and constitution of a new type of glucoside, which occurs in several South African species of *Acacia* (*S. African J. Sci.*, 32, 154; 1935). *Acacipetalin* is distinguished from all known cyanogenetic glucosides, including the corresponding product *sambunigrin*, which is found in the Australian acacia, in yielding neither aldehyde nor ketone when hydrolysed by acids. It is true that a small yield of acetone resulted from enzyme hydrolysis, but comparison of the molecular formula $C_{11}H_{17}O_6N$ of acacipetalin with that of linamarin $C_{10}H_{17}O_6N$, the β-glucoside of acetonecyanhydrin, led to the interesting discovery that the acetone was a secondary product, formed by disintegration of the unstable 'aglucone' or primary product of hydrolysis. The isolation of acacipetalin was rendered somewhat difficult on account of its association with *pinit*, the monomethyl ether of inositol, which is somewhat similar in properties. Eventually the glucoside was obtained as colourless crystals, which melt at 176° C. and are bitter to taste. The aqueous solution is lævorotatory, the value of $[\alpha]_D^{20°}$ being $-36{\cdot}6°$. Its molecular weight was determined cryoscopically, and ample chemical evidence was found of the presence in the molecule of prussic acid and one glucose unit. The results of acid hydrolysis were puzzling, since isobutyric acid was formed, but the key to the molecular structure was provided by subjecting the glucoside to the action of boiling baryta solution before attempting acid hydrolysis. The glucosidic linkage is practically untouched by the baryta, which merely hydrolyses the cyanogen group. This has the effect of stabilising the 'aglucone', which was identified as isobutyrylformic acid (α-oxo-β-methylpropane-α-carboxylic acid) $(CH_3)_2CH.CO.COOH$. This led to the establishment of the constitution of acacipetalin as the glucose ether of dimethylketenecyanhydrin $(CH_3)_2C : C(CN).O.C_6H_{11}O_5$, and it is tentatively suggested that the natural synthesis may be due to the condensation of glucose, acetone and formaldehydecyanhydrin.

# The Present State of the Theory of Natural Selection

ON May 14, the Royal Society held a discussion on "The Present State of the Theory of Natural Selection". Prof. D. M. S. Watson, opening the discussion, emphasised the lack of evidence that structural features are adaptive. In the brachiopod *Rhynchonella*, specimens with the inhalent and exhalent apertures completely abnormal occur abundantly in a random collection of large numbers, of different sizes, from one locality: the abnormality has not been selected out. Much more experimental proof of a selective death-rate is needed. While a change may take place independently on parallel lines, the rate may differ; there is a compensatory principle as in the evolution of the horse, in which an advanced rate of change in the teeth is associated with a backwardness in the case of the feet. The same adaptive structure may arise independently in nearly allied animals, or the same ends may be served by different adaptations in other groups. Perissodactyls show a dental peculiarity, increasing the grinding surfaces, which artiodactyls never do; what it is that prevents them from doing so, is a clue to evolution. Such types of evolution, common to great groups, have nothing to do with the evolution of specific characters. Do ordinary species differ from each other by adaptive characters? Quantitative results are of the utmost importance, yet they are not forthcoming.

Prof. N. Timoféeff-Ressovsky produced important figures dealing with relative viability in races of *Drosophila*. A state of over-crowding in a culture of the flies under optimum conditions can be produced by the introduction of others, leading to the death of a certain number. The percentage of viability of various cultures thus over-crowded shows that certain races will survive better than others at raised or lower temperatures. Although races from different areas may show no morphological differences, their viabilities at different temperatures agree with the climatic conditions of the areas they occupy. The populations of eastern Europe in a typical continental climate have higher viability at temperatures beyond normal in either direction than the north European race, which endures increased cold better than the Mediterranean race; this, on the other hand, endures increased heat alone better than the former. There is evidence that there do exist in the wild population sufficient allelomorphs to provide material for selection for climate, and that each of the mutants has its own specific relative viability dependent upon combination with other genes; small mutations affecting viability occur at least twice as frequently as lethals.

The differential elimination of genotypes of low viability was discussed by Prof. R. A. Fisher in the case of four species of grass locusts. There was unmistakable evidence of this, by deaths between the time of formation of the zygote and the time of capture, or between the time of capture and the time of formation of the next generation. In one case, not even complete sterility would explain the disparities observed; there must have been differential elimination of one genotype of low viability.

Prof. E. J. Salisbury urged that plants have much greater tolerance to supposedly lethal conditions than is thought to be the case; elimination is largely among juveniles. Survival is determined by reaction to competition for space; wild communities of an open character contain many microspecies. Allied microspecies grown in dense cultures show great mortality; a denser culture of a single than of mixed microspecies can be grown. Despite Darwin's axiom that competition is greatest between individuals of the same species, if they have no different competitive equipment, enormous numbers can live together without mortality.

The view that natural selection reduces polymorphism and favours distinct species in different environments was expressed by Dr. W. B. Turrill, who cited many cases of close adaptation to environment in plant species growing in contiguous areas, differing by well-marked characters yet each not spreading from its own area. The colonisation of a new area may be aided by a difference in habit, and Dr. T. J. Jenkin ascribed the difference between the annual rye-grass occurring in South Europe and the northern perennial species to an original divergence of habit which favoured different forms in different climatic environment. Such differences were not shown in morphology; the grasses are all diploids, and can be intercrossed without any noticeable change except a disturbance of meiosis.

Close adaptations were stated by Capt. Cyril Diver to be limitations; many species do not show them, and they may even be disadvantageous. Wide variability goes with adaptability; more common species are more variable than the less common, so that a successful species may be presumed to preserve wide adaptability. If close adaptations are a measure of the working of natural selection, wide adaptability, being incompatible with them, can scarcely be attributed to natural selection. The important thing for a species is to be tolerant and preserve a wide adaptability, and not close adaptations. This is best effected if there is no selective pressure to limit these adaptations; a condition of selective pressure causing close adaptation suggests that a species is losing rather than gaining ground.

There is difficulty in believing that adaptation is due to natural selection in cases where a new form is found living under the same conditions as its parent form. This point was also emphasised by Prof. R. Ruggles Gates; there is little evidence that natural selection is aiding the spread of new forms. Thus an apetalous form of *Saxifraga virginiensis*, having started in Manhattan, has become abundant in Massachusetts; a teratological form of *Drosera* spreading vegetatively has occupied an area of half an acre to the exclusion of the type form. The size of a population is of extreme importance; much depends upon whether all individuals can meet to interbreed, which is unlikely in widely scattered species. There is an effective range of interbreeding which will be less than the total range. Even migratory birds return to breed at the same spot, but plants have their effectiveness increased by necessary visits of pollinating insects or of wind. Therefore an element of chance may affect spread.

Dr. W. B. Turrill pointed out in his contribution that large changes of environment, such as is produced by man's deforestation, afford opportunities

for establishment of a new population, and that migration might be of less importance than changes *in situ*.

Theories of evolution were divided by Prof. R. A. Fisher into two kinds: those that explain adaptations, and those that fail to account for them. The development of the living organism must account for adaptations, otherwise (1) species must arise by an inner urge causing a progressive predetermined course undeterred by differences of birth or death, (2) the environment must govern the course of change. The "mutation theory, once popular among geneticists", omits the consideration of adaptations, and fails to explain the functions of organisms or their parts.

Dr. R. N. Salaman, in a few words at the end of the discussion, showed that a mutation might arise which only in certain circumstances might be of direct value to a species. A *Solanum* from Mexico, a country free from wart disease, has in Great Britain developed a recessive, bred true, which is immune to wart: a character that is useless in its native country but of the utmost value for England.

The value of protective adaptations in mimicry among arthropods was stressed by Prof. G. D. Hale Carpenter. Mimetic effects are produced in a variety of ways all serving the same end; a characteristic product of natural selection. Polymorphism in the case of mimicry is favoured by natural selection, contrary to the views of Dr. Turrill. A species gains by resemblance to different models or many kinds of inanimate objects, as this increases the work the enemy has to do in finding food. Habit plays an important part; conspicuous species furnished with unpleasant qualities have habits displaying them; mimics have habits enhancing the likeness, but often abandoned in real danger. The fact that mimicry deceives the artist but not the anatomist can only be explained by natural selection. The correspondence between models and mimicry in precise distribution is of utmost importance.

The question of numbers was discussed by Prof. J. B. S. Haldane. We are not in a position to detect evolutionary changes in a population at our disposal. Palæontologists agree that at least 20,000 generations are required to produce a recognisable change. If a gene is increased by 0·01 per cent, its frequency will increase in a random population from 0·01 to 99 per cent in 23,400 generations; but it would need a population of four millions to reveal it. This point had been also considered by Prof. Ruggles Gates, who said that in quite small populations the conditions would scarcely differ from chance survivals.

Prof. Haldane also said that new genes must be such as to decrease fitness, for if not they would already have spread through a population. The primary role of natural selection is to stabilise a species. Evolutionary changes are only to be expected as a result of drastic changes in environment; there is rarely direct evidence of selection. But such evidence exists in man, in the case of resistance to a disease: the progressive diminution of tuberculosis is due to natural selection developing immunity.

Parallel mutation was discussed by Prof. Ruggles Gates: it is so abundant, causing parallel evolution, that we must look on phylogeny not as like the usual Darwinian tree, but as the root system of a fig-tree which sends down parallel roots, descending and interlacing.

The facts of mimicry in insects, however, according to Prof. Hale Carpenter, cannot be explained by parallel mutation. The results in mimics and models are not the same, and similar effects are produced in different ways. One of a series of forms of a polymorphic mimetic species, of which the majority mimic species of one subfamily, may mimic a species of quite a different subfamily, and yet this form is linked with the others by intermediates.

# The Mysterious Number 137

IT is a remarkable fact, first made prominent by Sommerfeld's discussion of the fine structure of the hydrogen spectrum, that from three physical constants, $h$ (Planck's constant), $c$ (the velocity of light *in vacuo*) and $e$ (the charge on an electron), a dimensionless pure number can be formed, which usually occurs in the form $hc/2\pi e^2$, with the numerical value 137, or more accurately 137·2.

Dr. Max Born, in a lecture delivered to the South Indian Science Association at Bangalore on November 9, 1935 (*Proc. Indian Acad. Sci.*, 2, 533; 1935), declared that the explanation of this number must be the central problem of natural philosophy. Its existence can be ascribed to the fact that there are two different 'natural' units of length, a larger one $\lambda_0 = h/mc$ (the so-called Compton wave-length) taken from quantum theory, and a smaller one $a_0 = e^2/mc^2$ (the so-called radius of the electron). Their ratio is $2\pi$ times the mysterious number. After pointing out the great importance of this number in atomic physics, Dr. Born criticised the existing explanations of it.

Sir Arthur Eddington considers that it is associated with the number of degrees of freedom of a pair of electrons, and obtains the value 137. Dr. Born rejects this view, and seeks for an alternative explanation based on the new Born-Infeld-Pryce unitary field theory, which considers matter and field as one and the same. It involves a very large constant called 'the absolute field', which is the magnitude of the field in the centre of the electron. It is suggested that the number 137 is related to the neutralisation frequency of oscillation of a pair of electrons, one positive and the other negative (produced by light quanta passing the field of a nucleus), which approach and finally neutralise each other, emitting light quanta. Apparently the details of the calculation have not been worked out on Born's own theory, but by working on a somewhat similar theory Euler and Kockel (two pupils of Heisenberg) obtain the value 82·4. This differs considerably from the value 137·2, but Dr. Born considers the discrepancy not discouraging in view of the arbitrary assumptions made in the theory.

Dr. Born also uses the new field theory to explain the ratio of the proton and the electron, and obtains the number 2340. The experimental value is 1846·6, and the theory of Sir Arthur Eddington gives the value 1847·6 (*Proc. Roy. Soc.*, A, 134, 524; 1931).

# Prevention of Scaling of Mild Steel

IN the heat treatment of steel during manufacture, scale is formed on the surface by oxidation. This involves a loss of metal which in the aggregate is enormous. Moreover, the actual monetary loss is much increased from the damage to the surface, necessitating machining, and from the production of wasters outside specified dimensions.

The factors affecting scaling are temperature, period of heating, nature of the steel and furnace atmosphere; but of these, all but the furnace atmosphere are determined by considerations quite apart from those of minimum scale formation. The normal method of minimising scaling is to heat in a reducing atmosphere, which in the case of a coal-fired furnace means the emission of smoke and, at the same time, a fuel loss represented by the potential heat in the incompletely burned products of combustion. In the past, so well established was the tradition that a smoky atmosphere was essential to reheating furnaces, that steel-makers were exempt from many of the provisions of the Smoke Abatement Acts.

The influence of the composition of the atmosphere has received a systematic survey at the University of Leeds, and is described in a report by Dr. H. C. Millett and Prof. J. W. Cobb presented to the Institution of Gas Engineers in November last. Special attention was given to the influence of sulphur dioxide, oxygen or reducing gases in the furnace atmosphere. The 'neutral' furnace atmosphere, representing the products of the complete combustion of a fuel with no excess of air, was itself oxidising, water vapour being a more powerful oxidant than carbon dioxide. The addition of small and increasing percentages of oxygen to the 'neutral' atmosphere was accompanied by a rapid increase in the scaling, whereas similar small quantities of reducing gases were much less effective in restraining scaling.

Observations made upon the influence of the sulphur content of the fuel disclosed some interesting features. It was found, for example, that at 1,000° C., 0·10 per cent sulphur dioxide in the 'neutral' atmosphere, the quantity forthcoming from an average coal or fuel oil, gave the same increase in scaling as 1·0 per cent oxygen in the furnace atmosphere. These results bear on the question of the degree of purification necessary when coke oven gas is to be used for steel manufacture.

The authors conclude that the best results as regards freedom from scaling will only be obtained from furnaces so designed, constructed and controlled in use that an atmosphere containing no free oxygen and a minimum of sulphur dioxide and steam can be consistently maintained, but that complete elimination of scaling, as is sometimes required, can only be brought about efficiently by indirect heating, in which the bulk of the products of combustion does not come into contact with the metal.

# Petroleum Research

THE petroleum industry in America has been initiated and developed practically within the last thirty years; yet it is to-day there regarded as one of the most important industries. Not only is about eighty per cent of the rated horse-power of that country generated by oil and its products, but in addition the petroleum industry is one of the largest purchasers of steel, iron and motor-vehicles, etc. At the same time it is the second largest customer of shipyards, which supply the necessary tank ships for transport.

The Gulf Research and Development Corporation, Harmaville, Pa., has recently circulated a brochure which delineates the part played by industrial research in the solution of scientific, economic and social problems arising in the past in connexion with exploitation of petroleum, and indicates lines on which immediate problems are to be tackled. This is of particular interest in that it becomes evident during perusal that there is no phase of petroleum discovery, exploitation, refining or marketing which is not governed by laboratory or field data obtained as the result of intensive research. In exploration work, the geophysicist has superseded the less reliable, casual prospector, and by magnetic, gravitational, seismic or other methods is able to obtain a more or less accurate map of rocks lying many thousands of feet below the surface. In production, small samples of rock can be removed from the boring and analyses made to determine porosity, permeability and other relevant characteristics. Further, by correlation of results an estimate can be made of total thickness and areal extent of oil-bearing strata.

The annual losses of the petroleum industry from mechanical failure of equipment and corrosion amount to some millions of dollars. This alarming fact shows how vital it is that research should be prosecuted to find materials most suited to withstand the particular strain imposed upon them by petroleum engineering. Already it has been proved that steel of low carbon content and containing up to 4·5 per cent of nickel is better than the ordinary type for this work; this is only one of many important discoveries which help to reduce losses to the industry as a whole.

The aim of research workers is to reach a point where specifications can be issued to the industry for all classes of materials, which will guarantee maximum return in service for each dollar invested in equipment.

Enormous scope is offered to research workers in selection of the best product for a particular purpose. Already there are more than four hundred uses to which petroleum products are put, for each of which it is necessary to provide many different materials because of variations in application. When it is considered that technical progress is being made every day in each of the industries served by petroleum, then it must be admitted that the field of petroleum products research itself is correspondingly boundless.

## Educational Topics and Events

CAMBRIDGE.—B. C. Browne, of Pembroke College, has been appointed University demonstrator in the Department of Geodesy and Geophysics.

M. H. A. Newman, of St. John's College, and W. V. D. Hodge, of Pembroke College, Lowndean professor elect, have been appointed delegates from the University to the International Congress of Mathematicians to be held in Oslo on July 13–18.

GLASGOW.—Sir Hector Hetherington has been appointed principal of the University in succession to Sir Robert Rait who will retire on September 30. Sir Hector was principal and professor of philosophy in University College, Exeter, from 1920 until 1924, and has been vice-chancellor of the University of Liverpool since 1927.

The Senatus Academicus of the University has resolved to confer the honorary degree of LL.D. on the following, among others, at the graduation ceremony to be held in June: Prof. Ludwig Becker, emeritus professor of astronomy in the University; Prof. T. H. Bryce, emeritus professor of anatomy in the University; Dr. Ernst Cassirer, formerly rector of the University of Hamburg; Sir George Arthur Mitchell, president of the Mining Association of Great Britain; and Sir Leonard Rogers, president of the Royal Society of Tropical Medicine and Hygiene.

Sir Robert Muir is retiring from the chair of pathology at the end of the current session. Sir Robert has occupied this chair since 1899, and under his direction the Department has grown into one of the leading centres of pathological research, with modern well-equipped laboratories.

Profs. E. B. Bailey and Edward Hindle have been appointed official representatives of the University at the Harvard tercentenary celebrations.

Sir Daniel Stevenson, Chancellor of the University, has provided funds which amount in immediate capital value to £4,000 for an extension of the buildings of the Department of Botany. This very generous gift by one who has founded two chairs and a lectureship and has helped the University in other ways as well, will provide a laboratory for classes in advanced physiology and mycology and several private research rooms for members of the staff or research students. The present building, which was opened in 1901, thanks to the foresight of Prof. F. O. Bower, is well equipped with lecture-rooms and laboratories for large elementary classes, and with the additional facilities provided by the Chancellor's gift will be well fitted for advanced teaching and research in the more important branches of botany.

LONDON.—At the meeting of Convocation held on May 12, the following resolution moved by Mr. J. Stewart Cook was adopted by a substantial majority: "That Convocation is strongly of the opinion that adequate accommodation on the Bloomsbury Site should be reserved 'to promote research and the advancement of science and learning', to train graduates in the methods and spirit of scientific and technological research, to co-ordinate research work carried out under University Professors and Teachers at the constituent colleges, and, in particular, to provide facilities for external graduates desirous of undertaking post-graduate research work." A resolution moved by Dr. Brinley Thomas in favour of the application of the principles of the Ballot Act of [illegible] to university parliamentary elections was also adopted. A motion relating to the Bloomsbury site, of which Mr. T. Ll. Humberstone had given notice, was deferred to the next meeting to be held in October.

THE Annual Conference of the Association of Teachers in Technical Institutions will be held at Plymouth on May 30–June 2, under the presidency of Mr. W. T. Maccall, of the Technical College, Sunderland. The following resolutions will be considered: part-time and full-time day courses; overtime and shift system; school leaving age; extension of technical education; recruitment in industry. Further information can be obtained from the Secretary, Mr. J. Wickham Murray, 29 Gordon Square, London, W.C.1.

IT is hoped to make an appointment to a Busk studentship in aeronautics during July, 1936. The studentship is of the value of about £150 and is tenable only by a British subject. Research may be carried out either at home or abroad. Further information can be obtained from Prof. B. Melvill Jones, Engineering Laboratory, Cambridge.

## Science News a Century Ago

### Faraday and Schœnbein

ON May 26, 1836, Faraday entered in his "Diary" that he had "been making a few experiments this morning in relation to Professor Schœnbein's [of Basle] letter to me on the relation of Iron to Nitric acid and other metals". The experiments which were begun on that day were continued at intervals, as the entries show, until June 17. The letter from C. F. Schœnbein referred to, a lengthy one describing observations on the passivity of iron under certain conditions in nitric acid, was afterwards communicated by Faraday to the *Philosophical Magazine*, together with a dissertation of his own upon the subject, and published (*Phil. Mag.*, 9, 53; 1836) under the title "On a Peculiar Voltaic Condition of Iron".

Schœnbein's letter opens with the words: "As our continental and particularly German periodicals are rather slow in publishing scientific papers, and as I am anxious to make you as soon as possible acquainted with some new electro-chemical phenomena lately observed by me, I take the liberty to state them to you by writing. Being tempted to do so only by scientific motives, I entertain the flattering hope, that the contents of my letter will be received by you with kindness". Apart from its scientific contents, this letter is of interest as the first that Schœnbein wrote to Faraday. It was the beginning of a correspondence which extended over twenty-six years. Encouraged by Faraday's interest in his experiments, Schœnbein wrote again. From this beginning there grew up first an acquaintance and afterwards, when they had met, a warm friendship between the two men which lasted to the end of Faraday's life. The growth and continuance of their regard for each other may be traced in the valuable edition of "The Letters of Faraday and Schœnbein" prepared by Kahlbaum and Darbishire and published in 1899.

### The Whitby and Pickering Railway

ONE of the earliest sections of the present system of the London and North Eastern Railway to be opened for traffic was that from Whitby to Pickering

in the North Riding of Yorkshire. The line included nine bridges, one 312 ft. in length, and a tunnel 130 yards long at one end of the Vale of Goathland. It was opened on May 26, 1836, as a horse-worked railway. "The trains in both directions had heavy gradients to overcome, and, since they were contiguous and too steep for horses to surmount, a most ingenious method was employed. As the traffic for each direction was irregular and unequal, a tank was provided, mounted on railway wheels, at the top of the incline, which could be filled with water, to give a greater load than that to be hoisted. When the wagons had been pulled up the ascent the water was allowed to run away at the foot of the descending incline." (Sherrington.)

### Standard Scale of the Royal Astronomical Society

IN the *Athenæum* of May 28, 1836, is a long abstract of the Report on the Standard Scale of the Royal Astronomical Society, the consideration of which had occupied the Society on three evenings. The Report was drawn up by Baily. It contained first a history of the British Standards down to the destruction of the Parliamentary Standard during the fire at the Houses of Parliament in October 1834. In consequence of the destruction of the Parliamentary standard, said Baily, and the uncertainty whether the Government will think proper again to interfere and decide upon the subject, it becomes necessary that the scientific world should agree upon some definite standard to be appealed to on all occasions where great accuracy and precision are required. The important trigonometrical operations in England, Wales, Ireland and India will lose much of their value if they are not reduced to some known and permanent standard of measure, comparable with the standards of other countries where similar operations have been performed. A great variety of subjects might be adduced where extreme precision and accuracy are requisite, and it is hoped, he said, that the new standard scale of the Society will tend to remove some of the inconveniences and evils to which reference had been made.

### Natural History Museum at Leyden

IN a note in its column of "Miscellanea" in its issue of May 28, 1836, on the museums of Holland, the *Athenæum* said: "So much attention has been directed to public museums that [they were glad] to publish an account by a correspondent on the Museums of Holland. At the Hague there was a Gallery of Paintings, a Royal Museum of Curiosities, containing an ethnological collection, a Museum of National Antiquities, and the Royal Cabinet of Medals, Coins and Gems housed in the Royal Library. At Amsterdam there was a National Museum of Paintings, Statues, etc., and at Leyden a noble Museum of Natural History, enriched with the numerous collections from the Dutch Colonies in the East and West Indies, and the magnificent assemblage of natural objects which formerly belonged to that eminent naturalist Temminck, who is the director of the establishment. Several travelling naturalists were employed in searching for the varied treasures of nature in different parts of the world, and in transporting them to the grand repository at Leyden, which though supported by so small a state as Holland, would bear comparison with any museum in Europe."

## Societies and Academies

### DUBLIN

Royal Dublin Society, March 24. G. CRUESS-CALLAGHAN and M. J. GORMAN: Loss of colour in violet bacteria. Loss of colour which occurs in cultures of these organisms when they have been in cultivation for some time does not appear to be affected, as is known to be the case in other pigment-producers, by the composition of the medium. The temperature of incubation and the reaction of the medium were the only conditions of those investigated found to influence the colour of the cultures—most pigment being produced at 25°–28° C. and *p*H 7–8. ROBERT MCKAY: Method of infection of oat grain with *Ustilago Avenæ*, and the influence of external factors on the incidence of the disease. Flower inoculated oats were compared with grain contaminated previous to sowing in two successive years. Under the experimental conditions described, and using spores of high germination, shelled grain contaminated before sowing gave the highest percentage of infection, followed by that with hulls intact and then flower inoculated oats. In the case of flower inoculated oats, de-hulling reduced infection by 35–50 per cent, washing reduced infection by 32–56 per cent, and de-hulling and washing reduced infection by 62–96 per cent when such grain was sown. The conclusion arrived at was, that most of the infection was derived from viable ungerminated spores and not from resting mycelium.

Royal Irish Academy, April 27. J. G. SEMPLE: Contact conditions for surfaces. The theory of multiple contact of surfaces, at a point (node or binode) or along a curve, is discussed, purely synthetic methods being employed instead of the strictly algebraical machinery of previous investigators, notably Miss Hudson, in this field. After considering the analysis of binodes into chains of infinitesimal curves, total infinitesimal bases at binodes, the abstract $s$ fold curve strip, and the behaviour of the curve of intersection of two surfaces at a binode of $(s_1, s_2)$ contact, the author justifies the introduction of virtual genera for all the contact conditions concerned, and evalu[illegible] their postulation and equivalence, thus verif[illegible] independently, and in some cases extending, [illegible] Hudson's results.

### PARIS

Academy of Sciences, April 15 (*C.R.*, 202, 1317–1[illegible]). The president announced the death of Maurice H[illegible] past president of the Academy. EMILE JOUGU[illegible] Comments on the theory of waves of shock produ[illegible] in a gaseous atmosphere by a solid explosive. [illegible] HARMEGNIES: The movement of a plane [illegible] which remains homographic to itself. A. KO[illegible]GOROFF: The properties of Betti groups of lo[illegible] bicompact spaces. PAUL ALEXANDROFF and L[illegible] PONTRJAGIN: Varieties of $n$ dimensions general[illegible] LÉON DUBAR: The nature of the superficial [illegible]ductivity of cuprous oxide. After removal of ga[illegible] prolonged heating in a vacuum, the surface [illegible]ductivity of cuprous oxide becomes negligible. [illegible] is also the case with the fresh surface obtained [illegible] breaking a specimen in a vacuum. JEAN JAC[illegible] TRILLAT and SHIGUEO OKETANI: Electronic analy[illegible] the influence of a prolonged passage of a bundl[illegible] electrons through thin films. Local bombardm[illegible] with the electron stream causes changes in the sur[illegible]

of a thin gold film: the diagram becomes faint and finally disappears. A local rise of temperature caused by the electrons is suggested as the cause. EMILE PIERRET and CHARLES BIGUENET: The influence of a uniform magnetic field on the ultra-short waves obtained with a triode lamp. JACQUES BÉNARD and GEORGES CHAUDRON: Contribution to the study of the decomposition of ferrous oxide. MARCEL TUOT: Some secondary acyclic alcohols from $C_7$ to $C_{10}$. EMILE FLEURENT: Contribution to the physical and chemical study of bread-making. ALBERT PORTEVIN and ROBERT LEMOINE: The influence of various factors on the formation of graphite during the solidification of iron castings. LOUIS ROYER: The influence of the symmetry of the medium on the symmetry of corrosion figures in crystals. New examples. MARIUS BACCINO: Joint action of temperature and plant poisons on the development of young mammals. ALBERT GORIS and HENRI CANAL: The composition of the essence of *Primula auricula*.

### BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 32, No. 2; 1936). F. SWARTS: (1) On fluorocyclohexane. Method of preparation and various chemical properties of this compound are described. (2) On catalytic hydrogenation of organic fluorine compounds. The fluorine in fluorbenzene is readily replaceable by hydrogen in catalytic hydrogenation, but that in fluorocyclohexane is not. H. BUTTGENBACH: Measurement of the angle of the optic axes and determination of the optical sign by means of refractometry. Description of a method applicable to the case of a section parallel to the plane of the optic axes. V. WILLEM: The respiratory triphasism of the lizards. Differences in the respiratory movements of reptiles and mammals are examined. F. BUREAU: Integration of linear equations with partial derivatives. M. KOURENSKY: Generalisation of the Charpit-Lagrange method for the integration of first order equations with partial derivatives. F. BACKES: A characteristic property of *W* congruences. L. LONG: A plane net (4). YVONNE DUPONT: Electromagnetic force and couple in a gravitational field. B. ROSEN and F. MONFORT: A new band system of $Se_2$ in the red. A new system having the same upper level as the principal system $\Sigma \rightarrow {}^1\Sigma$. P. GILARD and L. DUBRUL: Introduction to the knowledge of the dimensions of the aggregates in silica glasses at high temperatures. Determination of the molecular weight of the polymerised aggregates in glasses from the variation of their viscosity with temperature.

### ROME

Royal National Academy of the Lincei (*Atti*, 22, 483–[illegible]; 1935). E. BOMPIANI: Some projective in[illegible]ants of curvilinear elements. R. EINAUDI: [illegible]chy's problem by means of differential equa[illegible]s with singular coefficients. L. SONA: Translo[illegible]ulatory current which invests a bilateral lamina. [illegible]odynamic applications (5). F. ODONE: (1) [illegible]ral equations of turbulence. (2) Absolute [illegible]ms of units of measurement. L. LABOCCETTA: [illegible]mination of the earth's dimensions by means [illegible]e mechanical method of Galileo through the [illegible]urement of the distance of inaccessible points. [illegible]PINO: The plane elastic problem and its inter[illegible]tion in space (1). L. GIALANELLA: Eccentricity [illegible]rbations in the problem of two bodies with slowly increasing masses. G. RAMACCIONI: Skeleton of *Elephas planifrons* found in the Pliocene of the Val d'Era. E. SILVESTRONI: Effects of mono- and bilateral subrenalectomy on the nuclear sizes of some endocrine organs. G. AUSTONI: Determination of ciliary movement and of its polarity studied by means of the ultra-violet irradiation of neurules of *Rana esculenta*.

### WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 22, 151–193, March 15). CLARK WISSLER: The excess of females among the Cree Indians. In aboriginal times, the excess was due to the hazards of hunting taking toll of young males; on the reservations, these hazards largely disappear and the proportion of males soon increased. A. M. PARTANSKY and H. K. BENSON: Anærobic fermentation of sulphite waste liquor by bacteria of freshwater muds. Methane-type fermentation, resulting in the gasification of all organic constituents with the exception of lignin, took place with every organism used (temperature 36° C., incubation time 340 days). The heating value of the methane and carbon dioxide produced was 18,730 horse-power hours per ton of pulp manufactured. The lignin can be oxidised slowly biochemically at high dilution. Its pollution effect is thus small, but it slows down gasification of the other constituents (sugars) of the waste liquors and should therefore be removed. LINUS PAULING and CHARLES D. CORYELL: The magnetic properties and structure of the hæmochromogens and related substances. The hæmochromogens (compounds of ferrous protoporphyrin and other substances, usually containing nitrogen) are characterised by two sharp absorption bands, at about 5600 A. and 5200 A. respectively. In a hæmoglobin derivative, this feature is correlated with a structure in which the four porphyrin nitrogen atoms form covalent bonds with a central atom (iron). The same correlation of spectrum and structure can be made for hæmochromogen-like substances not containing iron. DONALD F. JONES: Segregation of colour and growth-regulating genes in somatic tissue of maize. The evidence of colour- and growth-mosaics (areas of different colour and 'pits' or tumour-like growths respectively) on maize seeds suggests segregation of genes for these characters. CHARLES N. MOORE: Convergence factors for double series summable by Nörlund means. H. BATEMAN: Functional differential equations and inequalities. EDWARD KASNER: A complete characterisation of the derivative of a polygenic function. CHESTER STOCK: *Hesperomeryx*, a new artiodactyl from the Sespe Eocene, California. Teeth, fragmentary jaws and other skeletal remains of no less than a hundred individuals have been found. F. ZWICKY: Absorption of cosmic rays in the Milky Way. If cosmic rays are extra-galactic in origin, the intensity in directions from the centre of the Milky Way should be less than in directions from its poles, due to increased absorption. The difference should be detectable. Its observation would enable a determination to be made of the amount of matter in the Milky Way in the form of particles less than 10–100 cm. in dimensions. C. A. BERGER: Observations on the relation between salivary gland chromosomes and multiple chromosome complexes. The two types seem to have no connexion with each other; no evidence was found for the view that salivary gland chromosomes are compound in nature. J. VAN OVERBEEK: Different action of auxin-*a* and of hetero-auxin (preliminary note). Whereas the growth curvature of coleoptiles

stimulated by auxin-*a* is decreased by exposure to light, those treated with hetero-auxin are not affected. Sections of coleoptiles inactivate auxin-*a* but not hetero-auxin. C. A. G. WIERSMA and A. VAN HARREVELD: The double motor innervation of a crayfish muscle. Two motor axons only were found for the adductor muscle; the larger evokes a twitch and the smaller a slow contraction. A. G. JACQUES: The kinetics of penetration (13). Effect of *p*H on the entrance of potassium into *Nitella* at low concentrations. The lower the *p*H in the range used (6–8), the greater the tendency for potassium to enter the sap from solutions containing 0·00001 *N* potassium. The chloride concentration of the sap remained practically constant. The experiments were performed practically in darkness.

# Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

## Monday, May 25

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Sir Charles Bell: "A Recent Journey to Mongolia" (Film).

## Tuesday, May 26

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION), at 4.30.—Prof. J. W. Munro: "Insect Damage to Empire Products".

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. E. N. da C. Andrade: "Artificial Radioactivity".

WARBURG INSTITUTE, at 5.30.—Prof. Ernst Cassirer: "Critical Idealism as a Philosophy of Culture".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Eugene Schneider: "Recent Developments in Metallurgy and their Influence on Engineering" (Special Lecture).

GRESHAM COLLEGE, Basinghall Street, E.C.2, at 6.—A. R. Hinks, F.R.S.: "On Making Great Telescopes" (Gresham Lectures on Astronomy. Succeeding lectures on May 27, 28 and 29).*

BIRKBECK COLLEGE (NATURAL HISTORY SOCIETY), at 8.—Dr. George Taylor: "The British Museum Expedition to the Mountains of East Africa".*

## Wednesday, May 27

BRITISH PSYCHOLOGICAL SOCIETY (MEDICAL SECTION), at 8.30.—Symposium on "Patterns of Culture" to be opened by Prof. C. G. Seligman (joint meeting with the Royal Anthropological Institute).

## Thursday, May 28

LINNEAN SOCIETY, at 5.—Dr. W. T. Calman, F.R.S.: "The Origin of Insects" (Presidential Address).

ROYAL VETERINARY COLLEGE, at 5.30.—Prof. L. de Blieck: "Vaccination against Salmonella-Infection".*

CHEMICAL SOCIETY, at 5.30.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. R. Robinson: "Synthesis in Biochemistry" (Pedler Lecture).

## Friday, May 29

ROYAL INSTITUTION, at 9.—Dr. R. E. M. Wheeler: "Current and Forthcoming Archæological Exploration in the British Isles".

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ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS, May 30–June 2. Annual Conference to be held at Plymouth.

# Official Publications Received

## Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 34: Some Recent Investigations on the Corrosion of Tin. By D. J. Macnaughtan and Dr. E. S. Hedges. Pp. 18. (London: International Tin Research and Development Council.) Free. [204

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 7: Further Studies on Transport in the Cotton Plant. 3: Concerning the Independence of Solute Movement in the Phloem, by T. G. Mason, E. J. Maskell and E. Phillis; 4: On the Simultaneous Movement of Solutes in Opposite Directions through the Phloem, by T. G. Mason and E. Phillis. Pp. 50. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [214

Ministry of Labour. Report for the Year 1935. (Cmd. 5145.) Pp. vi+142. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [214

Annual Reports on the Progress of Chemistry for 1935. Vol. 32. Pp. 527. (London: Chemical Society.) 10*s*. 6*d*. [224

## Other Countries

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series, Vol. 21, Memoir No. 3: The Lower Palaeozoic Faunas of the Southern Shan States. By Dr. F. R. Cowper Reed. Pp. xii+130+7 plates. (Calcutta: Geological Survey of India.) 7.10 rupees; 13*s*. [274

Bergens Museums Skrifter, Nr. 18: Die nordischen Munidaarten und ihre Rhizocephalen. Von Prof. Dr. August Brinkmann. Pp. 111+5 plates. (Bergen: A/S John Griegs Boktrykkeri.) 15.00 kr. [284

The National Geographic Society and its Magazine. By Gilbert Grosvenor. Pp. 42. (Washington, D.C.: National Geographic Society.) [294

Proceedings of the United States National Museum. Vol. 83, No. 2982: Five New Genera and Two New Species of Unstalked Crinoids. By Austin H. Clark. Pp. 245–250. (Washington, D.C.: Government Printing Office.) [294

Brooklyn Botanic Garden Record. Vol. 25, No. 2: Twenty-fifth Annual Report of the Brooklyn Botanic Garden, 1935. Pp. 206. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [294

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 12: Availability of Education to Negroes in Rural Communities. By Ambrose Caliver. Pp. iv+86. 10 cents. Leaflet No. 46: Educational Facilities for Children on Federal Government Reservations, 1934–35. By Timon Covert. Pp. 9. 5 cents. (Washington, D.C.: Government Printing Office.) [294

The Egyptian University; Faculty of Science. Report for the Session 1932–33. Pp. 80. Report for the Session 1933–34. Pp. 128. (Cairo: Egyptian University.) [294

Smithsonian Miscellaneous Collections. Vol. 95, No. 4: Second Contribution to Nomenclature of Cambrian Trilobites. By Charles Elmer Resser. (Publication 3383.) Pp. 29. (Washington, D.C.: Government Printing Office.) [294

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 95: Reports of the Proceedings of the Special Plankton Meeting held on May 27th, 1935, at Copenhagen, and of the Special Meeting held at Videnskabernes Selskab's Premises on May 31st, 1935. Pp. 61. 3.00 kr. Vol. 96: Laws and Regulations in Summary concerning Salmon and Trout Fisheries. Compiled by T. E. Pryce-Tannatt. Pp. 37. 2.00 kr. Vol. 98: A Review of Fishery Statistics in relation to Wholesale-Index. By W. Nellemose. Pp. 72. 4.00 kr. Vol. 99: Scientific Report of the North-Western Area Committee for 1933–1935. By Dr. Å. Vedel Tåning. Pp. iii+34+28+20+12+6+20. 4.00 kr. (Copenhagen: Andr. Fred Høst et fils.) [294

Indian Central Cotton Committee: Technological Laborat[illegible] Technological Bulletin, Series A, No. 29: Technological Reports Trade Varieties of Indian Cottons, 1935. By Dr. Nazir Ahmad. [illegible] v+116. (Bombay: Indian Central Cotton Committee.) 1.8 rupees.

Conseil International des Unions scientifiques. Quatrième Rap[illegible] de la Commission pour l'étude des relations entre les phénom[illegible] solaires et terrestres. Pp. 159. (Firenze: Conseil International [illegible] Unions scientifiques.)

Rensselaer Polytechnic Institute. Catalogue: Undergraduate [illegible] Graduate Courses, including those arranged for Officers detaile[illegible] the Institute by the Government of the United States; Geograp[illegible] Distribution of Graduates. Pp. 223+4 plates. (Troy, N.Y.: [illegible] selaer Polytechnic Institute.)

Journal of the Faculty of Agriculture, Hokkaido Imperial Un[illegible] sity. Vol. 39, Part 2: Untersuchungen über die Hyochi-Bazille[illegible] Sake. Von Yoshio Otani. Pp. 49–142. (Tokyo: Maruzen Co., Ltd.)

Ontario Research Foundation. Report for the Year 1935. P[illegible] (Toronto: King's Printer.)

Mitteilung der Naturforschenden Gesellschaft Bern aus dem [illegible] 1935. Redaktion: Dr. G. v. Büren. Pp. xxxvii+104+5 p[illegible] (Bern: Paul Haupt.)

## Catalogues

Mandelix (Elixir of Ammonium Mandelate B.D.H.) in the treat[illegible] of Urinary Infections. Pp. 8. (London: The British Drug Houses, [illegible]

Catalogue of Secondary and Higher Text-Books. Pp. 232. (Lon[illegible] G. Bell and Sons, Ltd.)

Eastman Organic Chemicals. (List No. 27.) Pp. 116. (Roch[illegible] N.Y.: Eastman Kodak Co.)

Catalogue of Science and Technology, No. III: Annotated [illegible] Classified List of Rare and Standard Works on Exact and Ap[illegible] Science. Part XII: comprising XIV. Navigation, Naval Archite[illegible] and Engineering, and XV. Aeronautics. (No. 846.) Pp. 1198–1[illegible] (London: Henry Sotheran, Ltd.)

Neoket in the Treatment of Urinary Infections. Pp. 16. (Nottingham: Boots Pure Drug Co., Ltd.)

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# Science and Citizenship

DURING the past generation, scientific men have generally adopted an attitude of indifference to politics, and active interest or participation in political controversy has been discouraged by the leaders of British science. It must be admitted that there is much to justify a policy of aloofness. The world of political discourse is pre-eminently emotive, and political controversy proceeds with little regard for the standards which make up the professional ethic of scientific workers. The wrong things are done for the right reasons: the right things are done for the wrong reasons. Effective action calls for an opportunism alien to the temperament of genuine research, and the issues which divide political parties have little relation to the creative possibilities of applying science on a larger scale to the advancement of human welfare.

The position of agriculture is a sufficient illustration of this irrelevance. Within the framework of competitive private enterprise British agriculture has declined, while a lop-sided mechanical technology has brought forth increasing urban congestion increasingly vulnerable to chemical and aerial warfare. That biotechnology would receive a powerful impetus, and that science in general would benefit from the collectivisation of agriculture as part of a rational population policy, is a view which would receive a sympathetic hearing from many scientific workers who are not collectivists in principle. Also this is probably the last thing which our political collectivists would ever think of doing.

Of late there have been signs that representative leaders of the scientific movement realise a new danger in repudiating the responsibility of the scientific worker as citizen. The retiring address of Sir Frederick Gowland Hopkins from the presidential chair of the Royal Society, Sir John Orr's recent book and articles, and pronouncements by Prof. F. Soddy, Sir Daniel Hall, Dr. Julian Huxley, Prof. J. B. S. Haldane and others are symptomatic of a new orientation; and there is little doubt that they have the ear of the younger men of science. For various reasons—the betrayal of scientific freedom in present-day Germany, the frustration of medical progress by large-scale unemployment, the impetus which biological research has received from collectivist agriculture in the Soviet Union, and the shadow of a war which may destroy civilisation—there is a new awareness of social responsibility among the rising generation of scientific workers. There are no doubt many who agree with the views expressed in the letter on "Scientific Workers and War" which appeared in NATURE of May 16, in addition to those who signed it.

In great formative periods of British science, the man of science has been keenly alive to the social implications of his work. The "Invisible College" was formed by men inspired, as Spratt, its first historian tells us, by Bacon's eloquent plea: "The true and lawful goal of science is that human life be endowed with new powers and inventions." Boyle himself reiterated the common objective that "the goods of mankind may be much increased by the naturalists' insight into the trades". The British Association was formed to carry on the same task. Neither the character of political controversy nor the shortcomings of present parties is a sufficient reason for the attitude repudiated in an address entitled "Science in a Changing World" delivered at the Royal Institution on May 15. The man of science is a citizen as well as a scientific worker. If contemporary political discussion takes little stock

of the possibilities of human welfare which science can offer, it is his special responsibility to emphasise it by popular exposition or in an expert advisory capacity to any parties which will listen and act accordingly. The suggestion that he is neglecting his serious business if he does so is reminiscent of the Wee Free Minister who said that a man who plays golf neglects his business, neglects his wife and neglects his God. No one ventures to criticise the efficiency of a man of science because he is caught red-handed in the act of golf.

There are several ways in which scientific workers can exercise their responsibilities as citizens without committing themselves to a party label. One way is to co-operate with such organisations as the Next Five Years Group, P.E.P., the Malnutrition Committee, or the Engineers' Study Group, whose activities have been referred to in these columns already. Another is to press the claims of new personnel equipped with knowledge to bring the method of science into the field of social inquiry.

In his purely professional capacity the scientific worker remains an integral part of the society in which he lives, whether he chooses to accept responsibility for the uses to which science is put or prefers to make the plea that it is not his fault if poison gas is used against human beings instead of locusts. The extent to which pure science is subsidised is a measure of social confidence in its capacity to provide fresh food for applied science. In its turn, the encouragement of applied science depends on the social machinery for distributing as well as producing its amenities. What is called over-production is a misleading synonym for under-consumption, and under-consumption means that existing social machinery is embarrassed by "new powers and inventions". The continued progress of science therefore depends on the organisation of consumption.

The popular appeal made by the proposal for a moratorium on inventions is a real danger which now threatens scientific progress. The undercurrent of press criticism which places the blame for unemployment on a supposedly too rapid growth of technical knowledge is reinforced by fear of the vast destructive potentialities which science has conferred on warfare. To reflect that the responsibility lies with the Government may reassure the conscience of the individual man of science. One may well doubt whether such reflections will satisfy the plain man, or save science from the wreckage, if events shape as Mr. Wells forecasts. Brilliant cultures have been eclipsed in the past, and followed by ages of darkness. This may be the fate of our own social culture. If so, social aloofness may prove to have been the betrayal of the scientific movement.

# Lowell: Traveller and Astronomer

**Biography of Percival Lowell**
By A. Lawrence Lowell. Pp. x+212+5 plates. (New York: The Macmillan Co., 1935.) 12*s*. 6*d*. net.

THE life of Percival Lowell by his brother, the president of Harvard College, tells of a very attractive and enthusiastic man. His parents, who belonged to the aristocracy of Boston, brought him up to see that, whether rich or poor, he ought to do a life's work. Born in 1855, he graduated with distinction in 1876, and after a year's travel spent six years in business as the head of a large cotton mill. He resigned this post in 1883, and went to Japan to study the language and manners of the people. With Prof. Perry he made a trip from Tokio over the mountains to the other side of the island and was struck by the influence of the West on the political conditions of the country. On his return he accepted with diffidence an appointment as foreign secretary and counsellor to a mission from Korea to the United States. On his return to Japan he accompanied the mission to Söul. He gives an account of this journey with a study of the Koreans in his first book "Chösou—the land of Morning Calm—A Sketch of Korea".

A most interesting chapter taken from an article by Lowell in 1886 in the *Atlantic Monthly* describes the retreat of the Japanese Embassy from Söul after a Korean *coup d'état*. In 1888 he wrote "The Soul of the Far East" and contrasted the 'impersonalism' of the East with the individuality of the West. This book was translated into many languages and was greatly appreciated by such different critics as Dr. Pierre Janet, the French neurologist, Lafcadio Hearn and Dr. Clay Mackenzie, a Unitarian missionary to Japan.

Lowell made two further visits to Japan. One of these coincided with the murder of Mori, a progressive Japanese minister, of which he gave

an account in the *Atlantic Monthly*. In his next visit, in 1891, with his friend George Agassiz, he climbed the sacred peak of Ontake and collected materials for a work on Shintoism, published in 1895 with the title "Occult Japan or the Way of the Gods".

Lowell's interest in astronomy was awakened by Schiaparelli in 1891, and in 1893, at forty-eight years of age, he definitely forsook Japanese for astronomical researches. He was blessed with extraordinarily good eyesight, and wisely determined to find a site for an observatory where the atmospheric conditions would admit of its use. He sent Mr. A. E. Douglass with a six-inch refractor on a tour of investigation, and on his report decided on Flagstaff in Arizona at an altitude of 7,250 feet. Here an eighteen-inch refractor made by Brashear was set up and, after a year's observations in 1894, he concluded that Mars had intelligent inhabitants. The site was found to be so satisfactory that a permanent observatory was decided upon and a very fine 24-inch refractor by Alvan Clark was installed.

Here Lowell worked assiduously with W. H. Pickering through the greater part of each night on Mars, while Mercury and Venus were observed in the evening or early morning by A. E. Douglass. Schiaparelli discovered 140 canals, while between 700 and 800 were found at Flagstaff, a wonderful result when it is realised that, with the highest magnification, Mars is seen no better than the moon with the naked eye. His conclusions were embodied in two works "Mars as the Abode of Life" and "Mars and its Canals". Barnard, with an equally good eye, and with a large telescope which at moments of good seeing was equal to that at Flagstaff, denied the existence of these geometrical lines, but found short diffused hazy lines running between the black spots on the planet. The present position is summed up in Russell, Duggan and Stewart's "Astronomy" (p. 336).

"It is generally recognised that there exists an objective basis for the canals in the form of fine detail on the surface of Mars, and it is widely believed that these details have, in a general way, the streaky character of the canals; but the existence of a geometrical network is doubted or denied by a great majority of astronomers."

We cannot agree with the author on the value of Lowell's mathematical researches. His mathematics appears to us rather shaky. As an example we may refer to his paper on the oblateness of a rotating planet in *Phil. Mag.*, 19, 708. But we are indebted to this shaky mathematics for the discovery of Pluto. The discovery of Neptune by Leverrier and Adams resulted from a well-recognised discordance of 2′ from its theoretical place. On the contrary, the discordances of Neptune from its theoretical positions amounted to only a few seconds, which could be explained by a slight adjustment of the elements of its orbit. Comparison of Pluto's brightness with the satellite of Neptune leads to the conclusion that its mass is probably about one-tenth of the earth, and its effect on Neptune inappreciable. We must, however, express our admiration of the confidence Lowell had in his prediction, with which he inspired the search for the planet found in January 1930, more than thirteen years after his death.

Lowell added to the Observatory admirable spectroscopic equipment, and took part himself in observations for the rotation of the planets. He chose assistants of great ability, who have added to the renown of Lowell's Observatory. An appendix by H. N. Russell, giving an account of the later researches at Flagstaff, concludes this attractive biography. F. W. D.

# Universities of the British Empire

**The Yearbook of the Universities of the Empire, 1936**
(Published for the Universities Bureau of the British Empire.) Pp. xxxi+1080+26+vi. (London: G. Bell and Sons, Ltd., 1936.) 15s. net.

THIS annual, which 'came of age' last year, having been first published in 1914, is now so well known that little needs to be said about the current year's issue beyond that it maintains the high standard of its predecessors. By far the greater number of its eleven hundred and odd pages are devoted, as usual, to university staff directories, general information about the several universities and reports of events of the past year. Among the appendixes, those relating to post-graduate scholarships and grants for advanced study and research, and to centres of scientific research and information, have notably expanded in recent years, and now take up a tenth of the whole book. The problem of setting out the information collected on these subjects in a form readily intelligible and adapted for quick reference has been very satisfactorily solved.

The Yearbook is sparing in the matter of comparative statistics. Rows and columns of figures

are conspicuously absent. One knows that statistical tables are often worse than useless besides being costly, but the vacant space on page 18, for example, seems to cry aloud for a judicious summary of some of the returns published by the University Grants Committee. The nearest approach to a table of comparative statistics is Appendix xxv—students from other countries in the universities and university colleges of Great Britain and Ireland. This is compiled from returns received from all universities and university colleges with the exception of Trinity College, Oxford. (Why this particular college abstains does not appear.) An interesting fact revealed in this appendix is that German students (430) largely outnumbered the representatives of any other country except India (1,181), the United States (578) and South Africa (542). Most of them (257) were in the London colleges. Four years ago, German students numbered only 141. Of European countries France and Poland were the next largest contributors, with 78 and 64.

# Copper Resources of the World

**XVI International Geological Congress**
Copper Resources of the World. Vol. 1. Pp. vii+441+22 plates. Vol. 2. Pp. vi+443–855+ plates 23–41. (Washington, D.C.: XVI International Geological Congress, c/o U.S. Geological Survey, 1935.) 5 dollars each vol., 9 dollars the set, to Members; 6 dollars each vol., 10 dollars the set, to non-Members.

COPPER is one of the earliest metals known to man, and has always been an important commodity. Next to iron, it is the most valuable of base metals. In the early part of the nineteenth century, the world supply was obtained from the British Isles, chiefly from Cornwall, Devon and Anglesey, but about the middle of the century Chile became chief producer. During the last decade of the century the United States came to the front, a position she has maintained, although it appears that Africa attained a higher output figure in 1934.

World production in 1800 was about ten thousand tons per annum, but in the years preceding the Great War it had risen to close upon a million tons. During the War years this was increased by approximately a further half-million tons. For the first few years of the post-War period there was a slump owing to surplus stocks on the market, but in 1923 improvement set in and in 1926 the maximum War-time production had been exceeded. In recent years development of extensive deposits, for example, the so-called porphyry coppers, on a large scale by up-to-date methods has tended rather towards over-production, in spite of an ever increasing demand. The greater part of the copper used to-day is taken up by the electrical industry, and much of the remainder is used in alloys. In most of its uses copper has no substitute.

The two volumes under review constitute the sixth work of its kind compiled under the auspices of the International Geological Congress; the earlier publications dealing with iron, coal, phosphates, pyrite and gold. The present work was undertaken at the sixteenth Congress held at Washington in 1933, and its production was entrusted to a committee of well-known American authorities. It forms a comprehensive reference work, dealing primarily with the mode of occurrence of the various deposits. In the majority of cases the descriptions have been contributed by Government officials concerned or by authorities personally familiar with the occurrences, though naturally this has not been possible in all cases. An attempt has been made to give a fair expression of the available reserves of copper, though for obvious reasons such estimates are not claimed to be complete.

It is realised by the editors that methods of exploitation play a large part in controlling the relative importance of deposits. The scope of the work has not permitted this question to be dealt with systematically, but a section is devoted to methods adopted in some North American districts, with the intention of giving a view of current practice.

Although primarily a work on mining geology, it contains articles that give, from a more general point of view, a review of copper resources, dealing with the development of the industry, economic history and estimated world reserves. Maps accompanying the article on development, showing the movements of exports and imports, make the discussion more instructive to the average reader.

An idea of the present world distribution of sources of copper is conveyed by the statement on p. 21 that: "Of this record production [48 million tons since 1801], the United States has contributed about half, and 95 per cent of that has come from 15 districts in 9 States. Of the foreign fields, South America has four areas, three in Chile and one in

Peru. Canada has six, Mexico three, Africa four, and the remainder of the world about a dozen". A world map showing the distribution and relative magnitude of the various occurrences would have been helpful, not only in connexion with the above statement, but also to assist the reader in his perusal of the work in which the important deposits are described, as well as localities of classical and scientific interest which are no longer of economic importance.

The first volume is a memoir on the deposits of North America, while the second deals with South America, Europe, Asia, Africa and Australasia, and contains a full index. Of the books themselves all that need be said is that they are up to the usual high standard set by America. The few photographic illustrations are excellently reproduced in collotype, and the figures, maps, etc., though they must have been collected from many sources, are uniformly printed, clear and without that unnecessary decoration that gives a false impression of detail.

# Vitamins Applied

**Vitamins in Theory and Practice**
By Dr. Leslie J. Harris. Pp. xix+240. (Cambridge: At the University Press, 1935.) 8*s.* 6*d.* net.

IN this volume, informative in spite of its comparative brevity, meticulously accurate in its presentation of fact despite its simplicity of exposition, Dr. Harris has expanded four lectures given by him at the Royal Institution in 1934. In expanding them, he has clearly taken the opportunity of making the revisions rendered essential by the progress registered in even twelve months' work on the vitamins.

The informal atmosphere of the original lectures has been very skilfully maintained in the written form, the author having used diagrams, graphs and photographs in just the way that the good lecturer uses his lantern slides, that is, as a means of lightening his exposition by helping the listener—or reader—to visualise the facts recorded.

Dr. Harris has attempted, with undoubted success, to do several things in this book. It is no mere bibliographical summary of what we know to-day about vitamin chemistry, though this knowledge is admirably surveyed. The author has also been able to dispose of a number of nutritional old wives' tales. He makes short shrift of the instinct-merchants, of the *laudatores temporis acti*, who say that all was well before people bothered their heads about dietetic science, and he shows his iconoclastic tendencies by vigorously assaulting what Carlyle would presumably have called "The Hero as Scientist". He stresses in the appropriate places the co-operative and international nature of scientific progress, and he makes it clear to all able to read between the lines that the successful applications of scientific progress can only be achieved on a similar non-individualistic basis. He has further been able by means of several carefully chosen examples to illustrate the methods of biochemical research and the application of its results to clinical observations.

In a book of this kind, however jealous the author may be of scientific integrity, there are many occasions when he must express a purely personal opinion, give a purely personal interpretation of facts themselves not yet actually proved beyond a peradventure. Dr. Harris has, on such occasions, been nearly always most careful to indicate that he is expressing a view, not abstracting an experimental result. It is only on such occasions that one can differ with Dr. Harris, mildly or violently, and the difference itself must of necessity be one of opinion. It would be of little value, and it would take an unwarrantable amount of space, to enumerate these occasions here, and to state alternative views; but it may perhaps be permissible to mention one or two of such points of controversy.

Dr. Harris, in my opinion, still adheres with unnecessary rigidity to the purely dietary view of vitamin activity. The chemist seems to have suppressed the pharmacologist, who must surely recognise the possibility—the probability even—that substances of an intense physiological activity may have therapeutic activities comparatively remote from their 'normal' modes of action. Dr. Harris himself mentions the use of vitamin D "for callus formation or in tuberculosis", and one might parallel this by citing the treatment of purpura and certain other conditions with ascorbic acid. Only by an unjustifiable extension of the normal meaning of words could one describe these conditions as "vitamin deficiencies", and even Engelkes's suggested phrase, "*conditioned* vitamin deficiencies", seems rather to beg the pharmacological question.

It is from considerations of this kind that I have always felt some doubt about the deductions occasionally drawn from Dr. Thomas Moore's post-mortem examinations of the vitamin A reserves in human livers, quoted in this book. The presence

of these reserves is stated, in effect, to prove that administration of vitamin A could not have benefited the patient; this is surely to make quite a number of unproved assumptions about availability and mobilisation and the *site* of vitamin A action, as well as to rule out entirely a possible pharmacodynamic action of intensive vitamin A therapy. A similar consideration might be advanced about the curiously specific action of parenteral vitamin D treatment for certain skin allergies.

However, these matters take us a little far from Dr. Harris's mainly dietary contentions. About these there can be no cavil. Dr. Harris, as director of the Medical Research Council's Nutritional Laboratory at Cambridge, is, in a sense, a civil servant. It is to be hoped that his administrative colleagues in the Departments involved will read and mark his last chapter in particular, and outwardly digest for their respective ministers its devastating implications. The force of these implications is the greater in that Dr. Harris writes solely as a man of science, either stating proved facts or expressing opinions on matters about which objective and agreed judgments both can and will be reached sooner or later. Any political, and therefore subjective, consequences are not Dr. Harris's concern—at any rate as the author of this book.

Dr. Harris says in his penultimate paragraph that the co-existence of want and surfeit is not the fault of science; there are, however, many, and Dr. Harris is perhaps one, who are feeling less and less inclined to accept the comfortable corollary that no fault lies with scientific workers.

A. L. BACHARACH.

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**The Translocation of Solutes in Plants:**
a Critical Consideration of Evidence bearing upon Solute Movement. By Prof. Otis F. Curtis. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiii+273. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*. net.

THIS excellent monograph should be in the hands of every plant physiologist. Prof. Curtis is a recognised authority on the difficult problem of translocation in plants, and he is to be congratulated on the production of this book.

The first chapter is a specially well-balanced consideration of the historical side of the subject. Prof. Curtis has decided views on the particular functions of the different channels of transport in the higher plants, and considers that the phloem alone is sufficient not only for the downward translocation of elaborated metabolic products from the centres of synthesis; but that it is also the main channel for the upward translocation of mineral salts from the soil. On the latter point he will find the majority of plant physiologists against him. His survey of the brilliant series of investigations of Mason and Maskell on translocation in the cotton plant is on the whole fair, but tends to be biased by his own views on the function of the phloem.

The peculiar condition of 'negative gradients' of crystalloid nitrogen described by Mason and Maskell for the stem of the cotton plant, interpreted by them as a static gradient of crystalloid nitrogen mainly composed of asparagine, on which is superimposed a dynamic gradient of crystalloid nitrogen, finds a different interpretation at the hands of Prof. Curtis, who considers that it is "more likely to be due to a retention of the carbohydrate-filled tissues, of nitrogen that has never reached the leaves". This suggestion presumes that synthesis of organic from inorganic nitrogen can take place in regions other than the leaves, for example, the roots. This is quite possible, and there is experimental evidence to support the view. In face of these diametrically opposite interpretations of the same facts, further work is desirable on the matter.

The general appearance of this monograph is attractive and the diagrams clear and explicit. The text is not marred by misprints. The book can be thoroughly recommended as an up-to-date survey of the subject.

E. B. W.

**The Quantum Theory of Valency**
By Dr. W. G. Penney. (Methuen's Monographs on Chemical Subjects.) Pp. vii+95. (London: Methuen and Co., Ltd., 1935.) 2*s*. 6*d*. net.

As there are notably few text-books available dealing primarily with modern valency theory, a concise handbook is more than welcome. The object of the present monograph is "to explain in simple language the view-point of quantum mechanics on valency and related topics such as the architecture of molecules and the activation energies of simple reactions".

After an explanation of quantum numbers and the wave function of the electron, the hydrogen molecule is treated at some length on the basis of the Heitler-London electron-pair bond theory. A chapter follows on the method of molecular orbitals as applied to the hydrogen molecule and the general diatomic molecule, and another on the problem of the shape of molecules by the generalised Heitler-London method of localised pairs, illustrated for various radicals and molecules. The final chapter deals with activation energy, the three- and four-electron problem, the ortho-para conversion, and resonance.

Although present-day views on valency have developed largely through interpretation of molecular spectra, the author manages to avoid reference to spectral considerations. The text is explanatory and excludes mathematical deductions, but is by no means easy reading since it is, of course, highly condensed and its tone is mathematical throughout. The work is addressed especially to chemists, and those who have kept themselves equipped with a reasonable knowledge of quantum mechanical progress will value this concise treatment of a matter of essentially chemical interest.

N. M. B.

**A Description of Sherborne Scenery,**
its Nature and History in its relation to the Underlying Rocks; the particular Contribution to this Scenery made by the several Outcrops of Limestone, Clay or Sand; the Faults which displace the Rocks and thereby affect the Scenery; the peculiar manner in which the Hills wheel round about Sherborne; the Origin of Dry Valleys; the History of the River Yeo and the Formation of its Valley at Sherborne. By Joseph Fowler. Pp. iv+88+12 plates. (Sherborne: The Author, Sheeplands, 1936.) 6s.

THIS is a capital book written by a geologist for the people about Sherborne in Dorset. The treatment of the different formations is the main object, but it is told in such a manner that everyone can understand; and the make-up is well thought out—not too long and overcrowded.

Mr. Fowler has, in his introduction, described the aims and objects of the geologist. He finds the story that the rocks tell him more romantic than the most thrilling fiction, and to have the great advantage that it is true. The book is full of incident, but it never loses sight of its main geological object. His description of the Vale of Spackford is inimitable. The vale grey with the Lias, and the apple orchards far and wide, are different as possible from the Norman castles and the general hilliness of Dorset. His digressions are numerous, but will have some thread connecting with the main story; and although these digressions have a bearing on a theme which is quite another subject.

It is to this charming break up of the matter that the book owes its distinction, and doubtless Mr. Fowler will find many readers who are attracted by the subject, besides the geologists he caters for. Kestrels, sunken roads, snails, a promenade along the high Oolitic scars with the glorious view below stretching over the greater part of Somersetshire: when we compare this with the painfully accurate geological descriptions the contrast is very great. The print is very clear and well placed, and the reproductions of sketches clean and very charming. In conclusion, we may hope that Mr. Fowler will continue to write. There are plenty more subjects in the West of England which he might well take in hand.

F. J. S.

**Leitfähigkeit, Elektroanalyse und Polarographie**
Bearbeitet von W. Böttger, J. Heyrovský, G. Jander, O. Pfundt, K. Šandera. Pp. xii+343. (Physikalische Methoden der analytischen Chemie. Herausgegeben von W. Böttger. Teil 2.) (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 28 gold marks.

THIS volume begins with an account of conductometric titrations by Drs. G. Jander and O. Pfundt. Recent improvements in this field, for example, visual readings instead of telephone sound minima, have extended its applications, and conductometric methods now take their place with potentiometric and volumetric practice.

The second section, by Dr. K. Šandera, is concerned with the application of these conductometric methods to industrial analyses. They are convenient for testing the purity of organic preparations and of sparingly soluble salts, and for estimating inorganic salts in the presence of such soluble non-electrolytes as sugars.

Prof. Böttger's own contribution on electro-analysis occupies more than half the volume. He is thus able to deal fully with the methods he selects, which are those he recommends from wide personal experience. Many useful points, such as rapid ways of drying electrodes, are mentioned in connexion with individual estimations. Descriptions of the latest means of separating metals by electrolytic deposition will be of special interest to those concerned with these analytical processes.

The last section, on polarography by Prof. J. Heyrovský, gives a comprehensive survey of the researches with the dropping mercury cathode which began some fifteen years ago, and upon which more than two hundred papers have been published. It is stated that so little as 0·005 c.c. of solution can be examined, and that the method is sensitive to something like $10^{-6}$ gm. mol., per litre. As the utility of polarographic methods comes to be appreciated, they will doubtless find wider applications as a delicate means of analysis.

**Practical Bacteriology:**
an Introductory Course for Students of Agriculture. By Dr. A. Cunningham. Second edition, revised and enlarged. Pp. viii+203. (Edinburgh and London: Oliver and Boyd, 1934.) 7s. 6d. net.

THE appearance of a second edition of this book affords evidence of the need that exists for a simple laboratory text-book outlining a course of work that will give students of agricultural science some grounding in microbiological methods. On the whole the book succeeds in this object. It seems a pity, however, that the new edition should include so little reference to newer methods of research. Thus, some of the microbiological methods for the estimation of plant nutrients in soil such as Winogradsky's 'plaques moulées' method are eminently suitable for the student, to whom they would give some appreciation of the nutritive requirements of micro-organisms in the soil. It is also no longer true to say (p. 149) that "for the accurate determination of the numbers of micro-organisms in soil, microscopic methods are of little value". A method has now been developed that gives estimates of numbers more reliable than can be obtained by plating methods.

The mere qualitative examination of films of soil suspension, dried and stained with erythrosine, would give the student a useful idea of the appearance of micro-organisms in the soil itself, while the technique needed is simple and much quicker than is the Rossi-Cholodny technique that is given.

Chap. ii gives a clear and useful description of the microscope, but it is unfortunate that the student is not told how to obtain critical illumination. Ignorance on this point is unfortunately widespread, and it is of first importance that students who may later be engaged in research involving the use of high magnification should be taught to use correct illumination.

# Weights and Balances in Ancient Egypt

IN the study of ancient weights there has been a tendency to broaden the application of inference from comparison of different standards, until it has grown from the attempt to trace the origin of later standards to the modern field of research. The main objectives now are the far-reaching character of international trade and the common basis of exchange at a very early date and a closer linking up of the derived standards of later, and even present, days with the earliest originals.

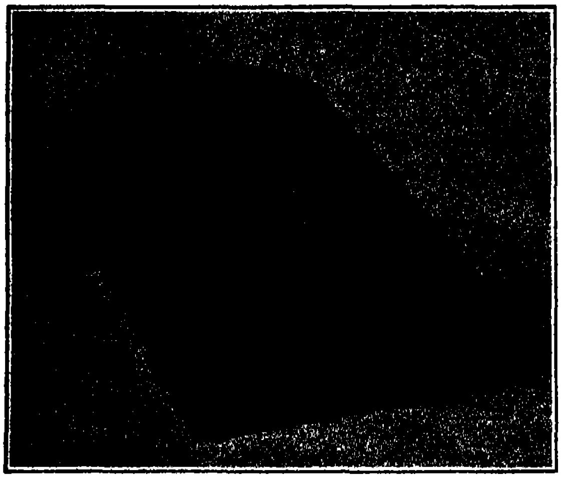


FIG. 1. Green felspar weight of Herfu; value, 100 units Beqa standard (c. 2000 B.C.). (University College)

Prof. S. R. K. Glanville, in his Friday evening discourse at the Royal Institution on "Weights and Balances in Ancient Egypt", delivered on November 8, 1935, and now available in printed form, while recognising the wider aims of modern metrological studies, confined himself of set purpose to indicating what we are justified in inferring, from the actual contemporary weights and from the pictorial representations of balances, as to the practice of buying and selling in private and public life throughout the dynastic period in Ancient Egypt.

The pioneer in the study of ancient weights is Sir Flinders Petrie, whose "Inductive Metrology" (1875) is a classic text-book; and by far the largest number of known Egyptian weights were discovered by him. A majority of them, some 3,000 in number, until recently formed a part of the Egyptological collections of University College, London, and a large representative selection is now on loan at the Science Museum, South Kensington. They range from less than 10 grains to more than a quarter of a hundredweight. Over the lower weights the series increases by decimal points of a grain and after that by grains, so that there are very few places in the sequence of the unit weights between 100 and 11,000 grains not represented by a specimen. The shapes vary as do the materials, most, however, being of stone of one kind or another. Petrie suggests that eight standards were current in Egypt from dynastic times, these representing a series of unifications of a much larger number of earlier standards. Two only were indigenous to Egypt, the Beqa (Fig. 1) and the Qedet, the remaining six being traced to various points of origin in the Near Eastern area. The archæological remains of even the pre-dynastic period are of sufficiently diverse character and origin to warrant a conclusion pointing to a volume of early international trade such as this variety of standard implies.

Turning to the balances, there must have been some primitive contrivance from pre-dynastic times. A beam of a balance at University College is made of limestone and may be of pre-dynastic date, but need not be later than the third dynasty (3000 B.C.), for with the tray of numbered weights depicted on the wall of the Third Dynasty tomb of Hesy at Saqqara, two exactly similar objects are shown. With the succeeding dynasty we reach a series of representations of balances, usually of the standard type, showing an improvement as the Old Kingdom develops. The most primitive is from a Fifth Dynasty tomb at Gizeh, in which the beam is a solid arc-shaped piece of wood slung from a joist between two uprights and having at either end what look like pans suspended from a single piece of string. The single string seems to be characteristic of representations of the balance in the Old Kingdom, the cord having a hook at the end. The standard balances, with this single exception, show one upright only, to which the beam was attached. An example of this period, figured in Davies's "Deir-el-Gebrawi", shows the plummet for the first time (Fig. 2). It appears that the string of the plummet is not attached to the upright, as it should be, but hangs from a long board, which in the New Kingdom became a neat tongue, rigidly attached to the beam and moving with it.

One other important representation of the Fifth Dynasty shows the simple beam suspended by a loop held in the hand. This is the only representation of a balance in the Old Kingdom not used for weighing out precious metals. The craftsman weighs the finished object to show that none of

the precious metal has gone astray. This raises the question of the use of the balance. All representations are in scenes in the tombs of great officials with responsibilities to the Crown, and all depict the exact measurement of precious metals. This fact, together with the evidence of representations of market scenes in which no balances appear and exchange is evidently by barter, and the early conception of the land as a single estate belonging to the king, justify the inference that for ordinary business no medium of exchange was in use in the Old Kingdom. The first evidence for the use of metal as a medium of exchange by the man in the street appears in the Eleventh Dynasty in the letters of Kekanekht to his son in Thebes, referring to the renting of land and the purchase of grain, linen and other essential commodities. It is implied that transactions are to be carried out with the aid of some medium of exchange, presumably copper.

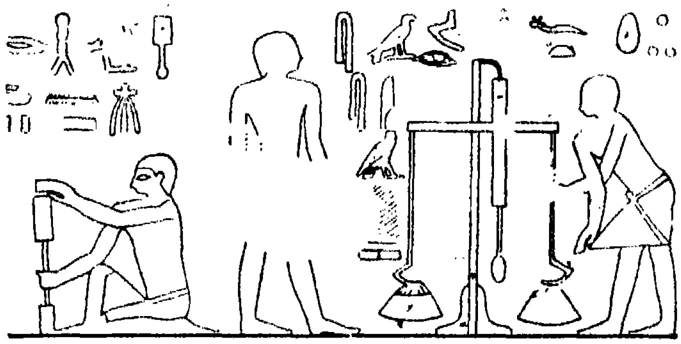


FIG. 2. Old Kingdom balance showing plummet (c. 2500 B.C.). By courtesy of the Egypt Exploration Society.

With the restoration of Pharaonic control under the Twelfth Dynasty, the estate system under the immediate control of the monarch was again in full swing and the balance, less frequently depicted, is still found weighing gold and silver for official purposes. The best examples indicate the next advance in balance technique in the form in which the single suspender at the end of the beam gives place to a proper pan suspended by four strings looped together through a hole in the beam (Fig. 3).

Though little remains of the period of the domination of the foreigner, the Hyksos kings, in the Seventeenth and Eighteenth Dynasties the legacy of the foreigner is made plain. Foreign standards show a considerable increase in use; the balance reaches its highest point of efficiency; but far more important are the changes in administration introduced in the early centuries of the new empire. In the height of imperial power no important tomb is without some reference to the importation of foreign goods. Although these goods to a great extent were prizes of war, it is highly probable that a large part of the scenes representing the importation of precious metals and manufactured goods show only one half of a picture of organised international trade. This is borne out by references in the Amarna letters to the gifts of gold from Egypt to rulers of western Asia. By this time the term *ynt* 'to bring', from which the term for gifts is derived, had acquired the meaning 'to buy'. On the other hand, the financial privileges granted to the priesthood indicate that the ruler no longer had a financial monopoly. In the light of these two influences on the economics of the New Kingdom, it is not surprising to find innovations in the detail of weights and balances.

The balance is represented more frequently than ever in tomb paintings and is usually of the standard type; but at least one example survives of the small hand balance, a beam and two pans now in the Science Museum (c. 1350 B.C.). The paintings show strong stands with carefully joined uprights with metal fittings for strength. Weights change form considerably, and bronze specimens in the form of ox, hippopotamus and gazelle become common, probably as a result of Asiatic influence. The type of balance now continued more or less unchanged until superseded by Roman instruments.

In the Eighteenth and Nineteenth Dynasties the balance continued to be used for weighing out gold to workmen within an official estate, or for the receipt of 'tribute' from foreign countries, or of duties, etc., within the State. The one exception is from a tomb now lost, which depicts the arrival of foreign boats from the Asiatic coast at an Egyptian port and includes representations of two hand balances (Fig. 4). It appears to be the first and only example of the use of the balance for private buying. Other evidence of a different kind, for example, a papyrus of accounts in Cairo,

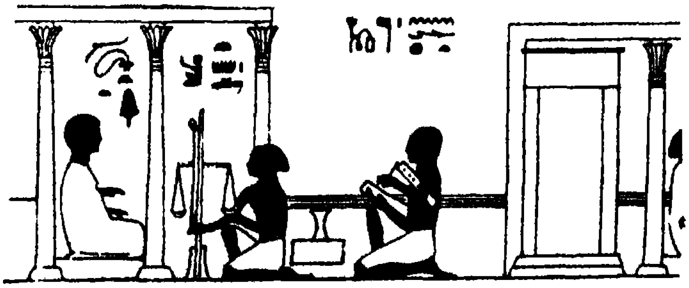


FIG. 3. Middle Kingdom balance with suspension cords (c. 2000 B.C.). By courtesy of the Egypt Exploration Society.

points in the same direction; but documents of the Twentieth and Twenty-first Dynasties indicate on one hand a breakdown of the old system sufficiently complete to allow of the development of a currency of sorts (the *shati*), and on the other commodity, for example, fish, of which this weight indicated their allowance. It may be asked if this evidence should not be taken to indicate that in earlier times also weights were used for such a purpose. To us it must seem extraordinary that

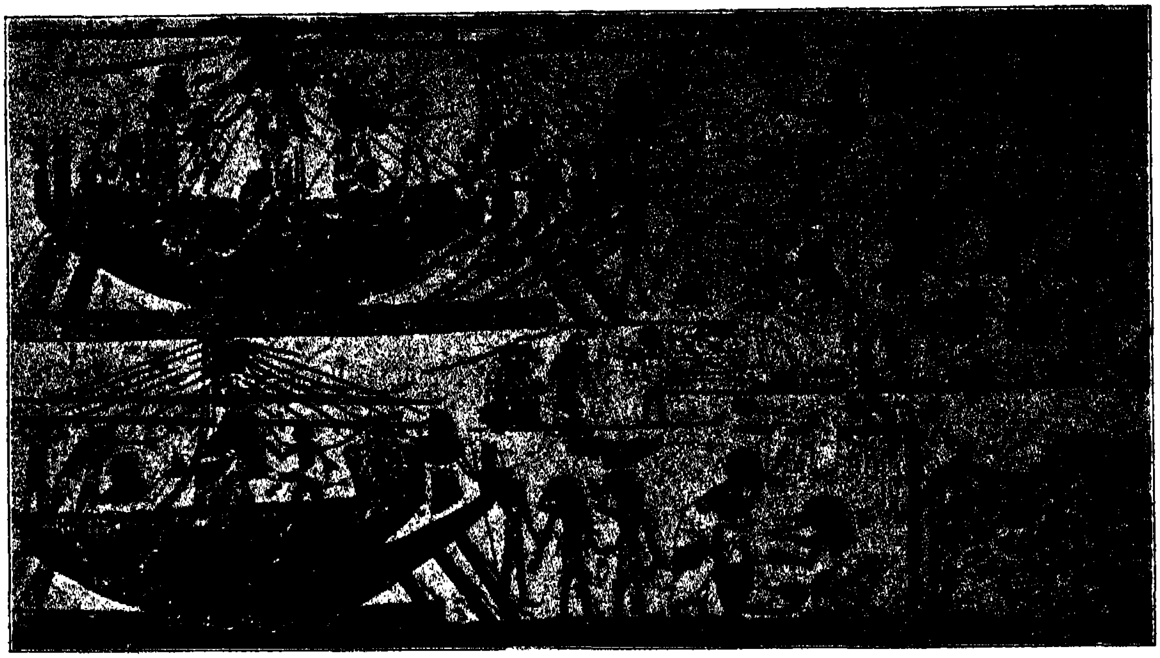


FIG. 4. Egyptian harbour scene: the balance in use for private transactions (c. 1250 B.C.). After a Theban tomb painting.

the essence of the old estate-cum-barter system being used by the Crown as in earliest times in its relations with the workmen employed on its monuments, who receive payment in food and commodities. Weights have been recovered with the names of the workmen and the name of the weights should have been used for more than two thousand years for one purpose only, before they were adapted for the direct weighing of commodities as we use them to-day. Until further information is available, it is unwise to speculate on this point.

# The British Association

## A FIVE-YEARS' RETROSPECT, 1931-35

FIVE-YEARS' PLANS are popular nowadays, and some of their begetters may have cause to remember with a wry smile Johnson's remark to Reynolds that "There are two things which I am confident I can do very well: one is an introduction to any literary work, stating what it is to contain, and how it should be executed in the most perfect manner; the other is a conclusion shewing from various causes why the execution has not been equal to what the authour promised to himself and to the publick".

The British Association has never, so far as we know, committed itself to any grandiose scheme of planning; but with the beginning of its second century, it has adventured upon a new course. As each quinquennium passes, the Association proposes to issue a review of its work—especially that work which arises out of the activities of the annual meeting, and is carried on in the intervals between the meetings. The first number of the series has just appeared.

The descent of two or three thousand members on a town in early September always causes something of a commotion. The livelier dailies blaze out into headlines which tell how a "Woman Scientist Amazes her Male Colleagues"; the sedater journals reflect on the potency of the weapons which science puts into the possession of

communities not, perhaps, as yet competent to use them wisely; the week passes, and the Association fades from public view.

Many of its members, even, fail to realise that the activities of the Association are, in the language of this retrospect, perennial. Its Council meets six times in the year, and deals carefully and exhaustively with various resolutions and recommendations which have been sent in from the Sections at the annual meeting. Many of these resolutions involve difficult points of local and national policy, and the consideration of the best methods of implementing them involves much labour on the part of the officers and of the Council. In the quinquennium under review, such diverse topics have been discussed as an inland water survey for Britain, the preservation of the countryside and national parks, the extermination of the musk-rat, the revision of Ordnance Survey maps, the aerial photography of topographical features, the diseases of the cricket-bat willow and the interchange of museum specimens—a selection which covers but a small fraction of the resolutions put forward in this period.

The work of the Association's research committees goes on steadily throughout the year; its volume and importance are, perhaps, scarcely appreciated at their true value, and the summary which appears in this retrospect is specially welcome.

The average number of research committees appointed or reappointed at each annual meeting during the period 1931–35 was no less than fifty-two, and the total expenditure on grants to research committees during this period was £6,174 (the average quinquennial expenditure on grants since 1831 has been £4,900.)

The Seismology Committee, with hospitality and some financial assistance from the University of Oxford, has continued the publication of the International Seismological Summary initiated by the late Prof. H. H. Turner. A catalogue of earthquakes from 1925 to 1930, based on the Summary, has been compiled by Miss E. F. Bellamy and published by the Association.

The Mathematical Tables Committee has earned the gratitude of all working mathematicians; the tables calculated and published under its direction have been issued in five volumes, the latest of which is a massive volume of factor tables published in 1935. Three volumes of tables of Bessel functions are in preparation, the first of which is in the press.

The freshwater biological station at Wray Castle, Windermere, originated in proposals put forward at the 1927–28 meetings of the Association, and the Association continues its support of the researches carried out here, at the marine laboratory at Plymouth, and at the zoological station at Naples.

It is impossible in a brief review even to catalogue the names of the committees. Committees on documentary and educational films, on the reliability of the criteria for the assessment of the value of vocational tests, on educational training for overseas life, on the teaching of general science in schools, on an inland water survey, on the reduction of noise—these may serve to show the variety and importance of the problems under consideration. It will be seen that many of these problems demand for their solution collective, sometimes national, action, and the Association's reports have in many instances served to influence and to direct the course of action to be taken. It is to be remembered that the reports of these committees are not only critical surveys of, and deductions from, existing knowledge. In a number of cases (the Committee on Noise, for example), the committees initiate and carry out definite schemes of experimental research.

One of the most congenial, if most responsible duties of the Association is that of guardian of Down House which, through the generosity of Sir Buckston Browne, it holds in trust as a national memorial. An average of 7,000 visitors is recorded for each year of the quinquennium, and the Genetical Society has set an example to other societies by holding one of its meetings at Down House in 1934.

Darwin's study seems more uncannily alive than ever. His books, which have been lent to Down House by the professor of botany in the University of Cambridge, have now been restored to the study which, in the careless order amongst disorder of its arrangement—specimens and opened letters on the table, microscope on the broad window-ledge, couch drawn into a convenient position for reading—might almost be in daily use. An onlooker, absorbed in the atmosphere of the room, would scarcely be surprised were he to hear the clink of the snuff-jar lid in the hall outside the study.

Down House is an invaluable national asset; it is a constant reminder of the work and personality of one of the greatest and most lovable minds that the nineteenth century produced. But it is the desire of the Association to make Down House something more than this, and the Association hopes to see the house a centre for appropriate regular scientific research. A beginning has been made, and in the next quinquennial report the Association hopes to record the fact that such work is well established.

In respect of its membership, the Association has outstripped all previous records, for in all its history there is no other succession of five years

in each of which its members have exceeded two thousand. The statistics for the quinquennium are shown in the accompanying table:

Meetings of the Association

| Year | Place | President | Membership |
|---|---|---|---|
| 1931 | London | Gen. Smuts | 5702 |
| 1932 | York | Sir Alfred Ewing | 2024 |
| 1933 | Leicester | Sir F. G. Hopkins | 2268 |
| 1934 | Aberdeen | Sir J. H. Jeans | 2938 |
| 1935 | Norwich | Prof. W. W. Watts | 2321 |

It is a remarkable record and one that may well stimulate the Council to widen the already wide activities of the Association, and it is no secret that the Council has in consideration the possibility of a considerable increase in the Association's work. Regular research at Down House and the initiation of quinquennial reports on the progress of science—reports which shall elucidate to the non-specialist recent developments in scientific knowledge—are two instances out of many possibilities.

But increasing activities mean increased liabilities, and such liabilities emphasise the necessity for increased endowments. In the quinquennium under review, the Association has received legacies of £2,000 from Sir Charles Parsons, £500 from Sir Alfred Ewing, £1,000 from Mr. Bernard Hobson, and a gift of £1,000 from the local Committee for the Leicester meeting. On the other hand, the Centenary Fund appeal, coming as it did at a time of financial stress, failed in its object, and the gift of £10,000, made in 1926 by Sir Alfred Yarrow, was made under the condition that it should be completely expended not later than 1947. The remark of Sir Josiah Stamp that "further endowment will be essential to consolidate the position which the Association has attained at the end of its first century" is very pertinent.

The Association is to be congratulated on the production of an interesting and valuable survey of the work of five very full years.

# Obituary

## Prof. J. Stoklasa

WITH the death in Prague on April 4 of Prof. Julius Stoklasa, agricultural chemistry has been deprived of one of its most active and distinguished exponents. Born on September 9, 1857, at Leitomischl in Bohemia, Stoklasa early showed his interest in science, and when only eleven years old was appointed curator of the school natural history collection. At the early age of sixteen years he developed an interest in plant nutrition and carried out experiments on the water culture of plants; the results he obtained were communicated to the famous plant physiologist Prof. J. Sachs, who replied at some length and encouraged the young worker to continue his experiments with the view of publishing them.

At about this time, Stoklasa commenced a study of the effect of sulphurous acid, hydrochloric acid and hydrofluoric acid on plants, which study proved to be a forerunner of the work published fifty years later under the title of "Beschädigung der Vegetation durch Rauchgase und Fabriksexhalationen". During the same period of his life, Stoklasa became interested in geology, and as a result of this he undertook a study of the weathering of rocks. Leaving school, he proceeded to the Agricultural Institute in Liebwerd, where his knowledge of inorganic chemistry, acquired at school, stood him in good stead and enabled him to take up the investigation of the quantity and quality of the salts valuable to plants which were carried away yearly by the River Elbe.

From Liebwerd, Stoklasa went to the Agricultural College in Vienna, where, working in the laboratory of Dr. Zeller, a son-in-law and a former assistant of Liebig, he published several investigations on plant biochemistry. On becoming *Privatdozent* at the University of Vienna, he worked in the plant physiological institute of Prof. Wiesner. Leaving Vienna, he went to Leipzig to study under Pfeffer and Ostwald, and obtained his doctorate for a thesis on the *physiological properties of the water-soluble* compounds of phosphoric acid contained in superphosphates. Recognising the importance of bacteria in the soil, he proceeded to Paris to study bacteriology at the Pasteur Institute, and on his return to Vienna he began to study the assimilation of atmospheric nitrogen by bacteria and plants.

For the next few years, Stoklasa was engaged in investigating the influence of phosphates and basic slag and other artificial manures on plant life. Starting an experimental station for beet sugar production in Prague, he became director of the section dealing with the physiology and pathology of the sugar beet; this gave him ample scope for his talents, and he proceeded to undertake an intensive study of nitrogen fixing and of denitrifying bacteria, and published a monograph on the phosphorus cycle in the soil.

Stoklasa's studies on intra-molecular respiration and the isolation of zymase from plants and animal sources were of fundamental importance. A study of soil fertility led him to investigate the significance of soil respiration in cultivated areas, and in 1926 he published a book entitled "Biophysikalische und biochemische Durchforschung des Bodens". He made important contributions to our knowledge of the physiological significance of phosphorus, sulphur, selenium and other elements, and published lengthy papers on the importance of potassium to the sugar

beet, and on the distribution of aluminium in Nature and its significance in the cultivation and metabolism of plants. In later years he studied the influence of iodine on the growth and development of plants and also the effect of radioactivity upon metabolic processes in plants and animals.

Stoklasa was professor at the Technical High School in Prague, director of the State agricultural experimental station and vice-president of the Czechoslovak Academy of Agriculture.

## Prof. Georg Wiegner

IT is with great regret that we have to announce the death on April 14 of Prof. Georg Wiegner, of the Agricultural Institute, Eidgenössische Technische Hochschule, Zurich. He had for some time been suffering from gastric ulcers, and underwent an operation which appeared to be successful, but peritonitis set in and ended fatally.

Wiegner was born in Germany, and received his training under Zsigmondy in Göttingen, then went straight to Zurich as professor of agricultural chemistry. Here he remained all his life, excepting that during the War he was temporarily in Germany for military service, and was wounded at least once. It is an open secret that he had been invited to a much more important chair outside Switzerland, but he preferred to remain in Zurich where, he said, he had been cordially received as a young and unknown man, and had familiarised himself with the agricultural problems of the Swiss farmers and discovered ways in which he could help them.

As might be expected from his training, Wiegner turned early to the study of the colloidal properties of the soil. It was at that time widely supposed, as the result of investigations by Way and by van Bemellen, that base exchange and some at any rate of the colloidal properties were due to zeolites in the soil. Wiegner took advantage of the possibility of obtaining permutite and other zeolites in quantity to make detailed studies by the new methods on base exchange, its nature and relation to the colloidal properties of the zeolite and of the clay, especially dispersion and flocculation, and he was able to work out an electrical hypothesis which threw considerable light on the whole phenomena. In the end it was shown in his laboratory that clay did not behave like permutite, and his hypothesis enabled him to explain the differences.

In 1930 Wiegner was invited to England to lecture at certain of the agricultural institutions so that members of the staffs might have the advantage of hearing his views and discussing problems with him. His lectures were published in the *Journal of the Society of Chemical Industry* for 1932 and constitute an admirable summary of the more important properties of clay and of zeolites.

In addition to these colloid investigations, Wiegner found time to study animal nutrition, choosing practical problems such as the drying and ensiling of grass, a very important matter in Switzerland; the evaluation of feeding stuffs with special reference to starch equivalents and gains in weight; and other subjects of farming interest. This work had the same high quality that characterised his soil investigations.

It was, however, as a teacher that Wiegner was supreme. He would come into the laboratory, call his research students together and start discussing some new idea, either his own or one of theirs, or he would sketch out some new experiment, and he would expect everyone to join in as eagerly as himself. On Saturday afternoons he would take a number of his postgraduate students for an excursion during which long discussions took place, lasting sometimes six hours or more, much of it in a village inn over beer, bread and cheese. The subjects were not necessarily scientific, but might even be political, and as his students came from many different countries and felt themselves entirely free and unconstrained, the discussions were often extremely interesting.

At the Congresses and Commission meetings of the International Society of Soil Science, Wiegner was always an outstanding personality; his geniality and kindliness towards his colleagues and his students endeared him to all who knew him. He added lustre to the Technische Hochschule of Zurich and he will long remain in the memory of his friends.

E. J. RUSSELL.

WE regret to announce the recent death at the age of fifty-eight years of Dr. Ernest Lobstein, dean of the faculty of pharmacy and professor of materia medica at Strasbourg, member of the Paris Academy of Medicine, and author of studies on the biology of the tubercle bacillus and chemical analysis of the mineral waters of Alsace, Bulgaria and Palestine.

WE regret to announce the following deaths:

Dr. William Bradley Coley, formerly professor of clinical surgery at Cornell University Medical College, New York, well known for his treatment of sarcoma by means of erysipelas and prodigiosus toxins, aged seventy-four years.

Prof. L. Fréderícq, emeritus professor of physiology in the University of Liège, aged eighty-five years.

Dr. Alfred Palmer, one of the founders, and from 1926 until 1930 president of the Council, of the University of Reading, on May 20, aged eighty-three years.

Sir Robert Rait, C.B.E., principal and vice-chancellor of the University of Glasgow since 1929, on May 25, aged sixty-two years.

Mr. Arthur J. Weed, known for his work on seismology in the University of Virginia, on April 15, aged seventy-five years.

ERRATA. Obituary of Prof. Karl Pearson (May 23, p. 857): Mr. Udny Yule informs us that the dates of Prof. Pearson's books should read as follows: "Grammar of Science", 1892; "Chances of Death, etc.", 1897; "Ethic of Free-thought", 1888.

# News and Views

## Linnean Society of London: New Foreign Members

THE following have been elected foreign members of the Linnean Society of London: Prof. M. L. Fernald, Prof. B. A. Fedschenko, Prof. P. Pelseneer, Prof. K. F. von Tubeuf and Prof. W. M. Wheeler. Prof. M. L. Fernald, curator of the Gray Herbarium, Harvard University, is well known for his highly critical work on the flora of eastern North America and for his studies in geographical botany, especially on the relations between his special area and Europe, which has had considerable influence on recent ideas about plant distribution. He has also published several important monographs on genera. He is editor of *Rhodora* and, with B. L. Robinson, edited the last edition of Gray's "Manual". Prof. B. A. Fedschenko is professor of botany in the University of Leningrad and curator of the herbarium in the Botanic Garden. His chief work has been on the flora of Asiatic Russia, especially Turkestan. In a long series of floras and monographs he has dealt both with the purely taxonomic aspects and with more general vegetation studies. He was formerly editor of the *Journal Botanique Russe* and has long taken a leading part in influencing taxonomic botany in Russia.

PROF. P. PELSENEER, who is permanent secretary of the Royal Academy of Sciences of Belgium, is well known for his long and continued researches on the Mollusca: his volume in Ray Lankester's "Treatise on Zoology" is still regarded as the classical authority on the anatomy and classification of the group. His later work on variation and heredity in Mollusca, carried out under very difficult conditions during the German occupation of his native country, is a mine of information, as is also his recent treatise on the ethology of the group. Prof. K. F. von Tubeuf is professor in the University of Munich. His name became prominent in Great Britain forty years ago on the appearance of W. G. Smith's translation of his "Diseases of Plants induced by Cryptogamic Parasites", a work still much used. Since then he has been mainly occupied with the study of the diseases of forest trees, and from 1915 has been associated with the editorship of the *Zeitschrift für Pflanzenkrankheiten*. His other chief interest is the genus *Viscum*, of which he published a large monograph in 1923. Prof. W. M. Wheeler, professor of entomology, Harvard University, is outstanding for his work on social insects and particularly on ants. Among his more important writings are "The Ants of the Baltic Amber" (1914), "Social Life among the Insects" (1923), "Les Sociétés d'Insectes" (1926) and "The Social Insects, their Origin and Evolution" (1928). He has also translated and published Réaumur's work on ants with the title "The Natural History of Ants" (1926).

## Sir Hector Hetherington

SIR HECTOR HETHERINGTON, vice-chancellor of the University of Liverpool, who has been appointed principal of the University of Glasgow in succession to the late Sir Robert Rait, has many associations with Glasgow, in that he is a graduate of that University, and was lecturer (1910–14) and professor (1924–27) of moral philosophy there. In the intervening years he held academic posts of importance elsewhere, being lecturer in the University of Sheffield in 1914–15, then professor of logic and philosophy in University College, Cardiff in 1915–20, after which he was invited to become principal and professor of philosophy in the University College of the South-West of England, Exeter. During the Great War he worked in the Intelligence Division of the Ministry of Labour and was chosen for work in connexion with the Treaty of Versailles. Following its signature, he went to Washington as one of the British assistant secretaries of the International Conference of the League of Nations. Sir Hector thus went to Liverpool with an outstanding record as a scholar and administrator, and for the past nine years he has been indefatigable in his service for the University in particular and for the general cause of education and social progress, and for hospital co-ordination. Among numerous other offices, he was elected in 1930 to serve on the Unemployment Insurance Commission. His knighthood this year was a just acknowledgment of his fine academic work and public service.

## U.S. Stratosphere Balloon *Explorer II*

A MORE complete account of the scientific results achieved in the stratosphere flight of November 11, 1935, has now been published in the May number of the *National Geographic Magazine*. The tube counter directional system for cosmic rays was described in NATURE of June 29, 1935, p. 1083, and it would now appear that some modification must be made in the results from *Explorer I*. At an altitude of 72,000 feet covering 96 per cent of the earth's atmosphere, the rays show no directional preponderance from the vertical to the horizontal. It follows that as those rays coming from the more horizontal directions increase with height, these are influenced by the earth's magnetic field. Swann's explanation of the distribution is that most, if not all, the rays observed are secondaries. The Stoss chamber for observing bursts did not show any abnormal increase in their number with height. The following numbers are given for cosmic ray activity: at 40,000 ft., 40·1 times that at sea-level (*Explorer I* on July 28, 1934, gave this number as 42·3); at 53,000 ft., 51·5 (Piccard in autumn of 1934 gave 53·2); at 57,000 ft., 55, a maximum, and at 72,395 ft., 42. A Wilson chamber was not taken up, but the next best method, of recording in the body of the photographic emulsion

of a plate, gave a track of an α-ray of energy $10^8$ electron volts. The ion content of the air roughly follows the cosmic ray activity at great heights. Previous records only went up to 30,000 ft. In these experiments, the maximum was observed at 61,000 ft. of 81 times that at sea-level, and at the greatest height of 72,000 ft. this figure fell to 50. There may be some connexion between this and the observed decrease in the strength of radio signals received on the ground from above a height of 60,000 ft. Other results quoted are that 20 per cent of the ozone content of the atmosphere lies below 72,000 ft., the composition of stratosphere air is insignificantly different from that at sea-level and above 60,000 ft. only moderate wind velocities ranging up to 42 miles per hour are met with. From the temperature–altitude chart given, it appears that the temperature ranged round about − 70° F. from 35,000 ft. to the maximum heights from 9.40 a.m. to 2 p.m.

### The Impact of Science on Social Organisation

THE twenty-eighth Moncure Conway Memorial lecture was delivered on May 20 by Prof. Lancelot Hogben, who dealt especially with the impact of scientific knowledge on contemporary social organisation. The democracies of Western civilisation, Prof. Hogben said, have reached a crisis with which a social personnel of government trained in a humanism without roots in scientific technology are not equipped to deal. Current political thought is permeated with a body of economic doctrine which includes within its scope no conspectus of emergent technological forces reshaping national policy and international relations. The result is a growing distrust of the powers of education and rational persuasion. In the long run, the stability of Western democracy must depend on whether we can devise an education adapted to the conditions of a society which makes increasing demands on technical knowledge. The necessary reorientation of cultural values and of research in social studies can only be brought about by enlisting to the task a new personnel with naturalistic training and the executive competence which laboratory experience calls forth. The primary business of social inquiry should be devising the social machinery to make available for human welfare the plenty which science offers. The lecture is published by Messrs. Watts and Co., 5 and 6 Johnson's Court, Fleet Street, London, E.C.4 (price 2*s*. net; by post, 2*s*. 2*d*.).

### Chemistry of Crystals

THE thirty-fourth Bedson Lecture was delivered at Armstrong College, Newcastle-upon-Tyne, on May 8, by Dr. C. H. Desch, his subject being "The Chemical Properties of Crystals". Dr. Desch said that a solid metal is a crystalline mass of which the chemical, as well as physical properties are anisotropic; acid attack, for example, not being uniform, but producing geometrically shaped pits indicating the symmetry of the constituent crystals. This constitutes a part of the evidence for a secondary or mosaic structure in crystals. The boundaries between the individual crystals have different chemical properties from the mass. Their form corresponds with that of foam cells, being determined by surface tension, and in certain alloys they can be separated by the action of specific reagents. Certain brasses containing aluminium, for example, fall to pieces, the grains separating like sand, when placed for a few seconds in a solution of mercurous nitrate. In the stainless steels, such intercrystalline disruption is explained by the segregation of carbides, but in other instances no boundary constituent has been detected. The stability of iron, aluminium and stainless steel in air is explained by the presence of a surface film of oxygen or oxide. The greatly increased chemical activity of a metallic surface under high local pressures, as in abrasion, was also discussed. The effect known as 'corrosion fatigue' is caused by the combined action of alternating stresses and chemical attack, in which the properties of the film and of minute cracks both play a part. Dr. Desch concluded with an account of the transformations within solid solutions, including the work of Prof. W. L. Bragg on the changes from disorder to order in a lattice.

### Lectures to Secondary School Pupils

WITH the object of bringing young people from secondary schools into contact with some aspects of progressive science and its applications, the British Science Guild arranged last year for two lectures by Mr. C. C. Paterson, director of the research laboratories of the General Electric Company, to pupils from secondary schools for girls in the London area. The lectures were delivered at the Institution of Electrical Engineers, and the subject was "The Electron Liberated: its Industrial Consequences". Sir Albert Howard, the honorary secretary of the Guild, has provided for the continuance of this successful enterprise under the title of the Gabrielle Howard Memorial Lecture; and on Tuesday and Wednesday last, May 26 and 27, Prof. W. L. Bragg delivered this lecture upon the subject of "Telegraphs and Telephones". The lecture on the first day was to boys from London Secondary Schools, and on the second to girls from London Secondary Schools. On both occasions, the lecture was given at the Royal Institution, by kind permission of the Managers. Through the courtesy of Messrs. G. Bell and Sons, the young people who attended the lectures were able to take away with them a pamphlet containing a reprint of the chapter on telegraphs and telephones from Prof. Bragg's book on "Electricity" just published by Messrs. Bell.

### Whirlpools and Vortices

AT the Friday evening discourse at the Royal Institution on May 22, Prof. E. N. da C. Andrade discussed "Whirlpools and Vortices". The best example of what is ordinarily thought of as a vortex is the whirlpool that is formed where the water runs out of a bath or basin. There is a widespread belief that this always spins one way, clockwise or counter-clockwise, and that this is due to the rotation

of the earth. Actually, however, if the water is allowed to come to complete rest in a vessel where the hole is accurately in the middle, and if the plug is carefully withdrawn, no whirlpool is formed. The whirlpool that is generally observed is due to some slight rotation given to the water near the edge of the vessel, which, by the laws of fluid motion, becomes very much accentuated where the water runs out. The direction of the spin depends on the direction of this slight motion. If the spin is actually always in the same direction in a particular bath, it is because of some chance influence, such as the position of the taps. The spin of the earth should actually give rise to a rotation of the water where it runs out, but the effect is far too small to be observed with a bath or basin. Where a large still sheet of water runs out through a vertical pipe, as at the intake of a water turbine, the effect should, however, be large enough to observe. It is, in fact, found that under these conditions whirlpools form, and that the spin of the water is in an opposite direction in the northern and in the southern hemisphere, as it should be. The consideration of vortices is extremely important for aircraft or other bodies moving through the air, and the whole object of stream-lining is to avoid the formation of vortices, which fritter away energy. The sensitive flame, which ducks in response to sounds, is, it turns out, an example of vortex motion, the vortices being produced as a consequence of the sound vibration.

### New Guinea Exhibition

AN exhibition of ethnographical objects from New Guinea and the islands of the Malay Archipelago under the auspices of the Royal Anthropological Institute opened at 10 Grosvenor Square, London, S.W., on May 26, and will remain open for three or four weeks. The specimens were collected by Lord Moyne during a cruise on his yacht *Rosaura* between November and February last, and with them is a remarkable series of photographs taken at the same time by Lady Broughton. The section of the exhibition which will afford the greatest interest is that illustrating the culture of the newly discovered Aiome, a light-skinned pygmy race inhabiting the hills near the Middle Ramu River in the mandated territory of New Guinea, who had not previously had any contact with white civilisation. Their skin is only slightly darker than that of a well-sunburned European, and their hair a very dark brown. The average height is 4 ft. 6½ in., male, and 4 ft. 2 in., female. They are surrounded by dark-skinned tribes of normal stature and the general New Guinea type. Their appearance is well illustrated in a number of photographs, which show the mode of wearing the articles of adornment included in the collection, such as bands made up of stems of *Dendrobium* and threaded grass seeds, and tree-bark head-dresses. A collection of skulls comes from a deserted village, in which they were stored in bundles outside or inside the houses. This collection includes two very distinct types of head, one large and one small. The former is distinctly Australoid in appearance, with prominent brow ridges and receding forehead. It is remarkable as coming from New Guinea. No explanation of the abandonment of the village was obtained, though it was found to be full of the possessions of its former inhabitants, including a number of objects of the greatest cultural interest, among them drums, carved shields and curious head-dresses of possibly ritual purpose.

### Homer's Troy

A THIRD, and possibly final, stage in the archæological exploration of Troy has been reached with the excavations organised by the University of Cincinnati under the field direction of Dr. Carl Blegen, formerly assistant director of the American School of Archæology at Athens. It is remarkable that of the three great sites of Homeric civilisation, Troy, Mycenæ and Tiryns, the first-named, which inspired the excavation of the archæological sites of the eastern Mediterranean, should still, at the last, afford a problem in the exact determination of its chronological and cultural relations. Schliemann's final identification of the Sixth City at Hissarlik, and not the Second, as the Homeric Troy in 1890, and Dorpfeld's demonstration of a sequence of nine phases in the history of the city, extending from the Early Bronze Age to Roman times four years later, satisfied a generation which knew not Knossos and the history of Helladic culture. It has since become evident that the Sixth City, notwithstanding Mycenæan contacts, is neither completely contemporary with, nor its culture identical with that of, the Mycenæan age. The work of the American expedition, as is indicated by Mr. E. J. Forsdyke in his lucid summary of the present position of the archæological and historical problem in *The Times* of May 22, has confirmed this by showing that the Sixth City goes back to Pre-Mycenæan Middle Helladic, and that "the Achæan moment", the period when the Achæan military aristocracy held sway, fortified by matrimonial alliances with Mycenæan heiresses, which corresponds with the conditions of the Homeric world, is represented by an inferior reconstruction after the Sixth City had been destroyed by earthquake about 1300 B.C., in which the walls were repaired in rougher masonry and the houses irregularly built with odd stones from the ruins. About 1200 B.C. this Seventh City was destroyed by fire. It was rebuilt and inhabited, presumably, by the Achæan conquerors.

### Co-ordination of Research

THE Research Co-ordination Committee, which was formed a few months ago as the result of an informal meeting of persons connected with organisations interested in the application of science to present-day problems (see NATURE, February 22, p. 311), reported on its activities at a meeting on May 23 to the group from which it arose. The Committee, after making a preliminary list of problems which need co-ordination, decided to consider one or two in detail and to work out a technique of co-ordination that could be generally

employed. This, it is claimed, has been achieved. Given two persons sufficiently interested in co-ordinating the material relating to an important problem, and ready to devote to it one full evening a week, the Committee will undertake to help them in elucidating the various aspects of the problem and in bringing together the organisations concerned. The Research Co-ordination Committee has been fortunate in obtaining the co-operation of many organisations interested in various aspects of the housing question. Among these are the Housing Centre, Architectural Association, Modern Architectural Research Association, Architects and Technicians Organisation, Society of Women Estate Managers, Kitchen Planning Centre, Women's Gas Council, Institute of Sociology, etc. The Building Research Station of the Department of Scientific and Industrial Research and the Housing Section of the Ministry of Health have also provided assistance.

### Lighting and Heating Research

A CONFERENCE on lighting, space heating and hot water supply in low-cost housing, arranged by the Housing Centre, 13 Suffolk Street, S.W.1, was held on May 25 and 26. In the opening address, Lord Elton referred to cheapness, efficiency and health requirements as the main directives in modern low-cost house building and contrasted them with the durability, dignity and individuality of the Tudor period. In the discussion that followed, Prof. Patrick Abercrombie, who was in the chair, pointed out that standardisation can be applied to desirable as well as undesirable features, and other contributors suggested that perhaps dignity and individuality can now be transferred from the individual house to a planned estate as a whole. Sir Richard Paget, in his address as chairman of the business part of the Conference, gave a broad view of some of the avenues opened by scientific research in the utilisation of our national fuel assets, and pointed out several cases of present wastage. He directed attention to Sir Richard Gregory's remarks at the Royal Institution on the mission of science in the changing world of to-day. He also stressed the urgent need of an impartial investigation of the monetary system, and ended by pointing out the value of technical conferences in bringing together experts and enabling them to synthesise their ideas into one connected whole.

THE relative merits of gas, electricity and other forms of heating were brought out in a series of papers contributed by the British Commercial Gas Association, British Electrical Development Association, Coal Utilization Council, London and Counties Coke Association and by other organisations and individual specialists. The convergence upon a common problem of these diverse interests has been a valuable feature of the Conference. The need for an impartial body to collect and collate the data supplied by the various parties was brought out, and both the Housing Centre and the Research Co-ordination Committee have expressed their willingness to help in this work. The immediate task of such a body would be, first, to find out what the consumer actually uses and is likely to expect with an increased standard of living and, secondly, how far his requirements can be satisfied with existing methods and appliances, or such improved forms as the advance in technique renders possible.

### Radium Research at Birmingham

FOR some time the Physics Department of the University of Birmingham has had charge of 0·5 gm. of radium, which has been used for supplying local hospitals with radon. This radium, which belonged to the Radium Commission, has recently been allotted to the General Hospital of the City for a special purpose. It therefore appeared likely that the Radon Laboratory of the Department of Physics at the University would be put out of action. Thereupon Sir Gilbert Barling issued an appeal for a fund to provide the University with a supply of radium of its own. The appeal met with a most generous response, and with the accruing money it is proposed to buy for the University 1 gm. of radium, so that the Radon Laboratory will be able to continue to supply radon to hospitals as before, and the Physics Department will have radium available for scientific research. The Pro-Chancellor (Mr. Walter Barrow) has expressed on behalf of the University his warmest thanks to Sir Gilbert Barling for his energy and initiative and to the donors for their generous response.

### Conference on Atmospheric Pollution

THE half-yearly Conference of representatives of local authorities and other organisations co-operating with the Department of Scientific and Industrial Research in the investigation of atmospheric pollution was held in the offices of the Department on May 25. The Conference received from Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, a report on the progress of research. He announced that the Committee has decided to undertake an intensive survey of the pollution in and around an industrial centre and has selected the city of Leicester, the geographical position of which in relation to the surrounding country and neighbouring centres of population appears to render it particularly suitable. The Conference noted with interest that the London County Council has intimated that it is extending its investigations and that it is arranging for observations at a rural institution and a seaside institution belonging to it. Reports from Glasgow and from Sheffield and Rotherham were presented on comparative determinations of sulphur in filtered and unfiltered air. Measures for reducing pollution due to the emission of ash and grit from chimneys were also discussed. At its previous meeting, the Conference considered a proposal by the London County Council that the machinery of the Conference might be used to secure financial contributions for investigations into means for reducing this type of pollution. A committee, which was appointed to meet representatives of the Department for the discussion of practical measures, presented a report for discussion by the Conference.

### Borax as a Fertiliser

IT has long been known that a group of about ten elements plays an essential part in plant nutrition, but it is only during recent years that it has become recognised that other elements are of equal importance, though in such small amounts that their presence was previously unsuspected. Manganese and boron are the outstanding examples of these minor elements—'minor' only in the sense that the requisite quantity is so small. Copper, zinc and other substances may also play an essential part in specific cases, and active research is in progress. The case with regard to boron is of definite economic importance. The pioneer work of Agulhon (1910) and Warington (1923) established the fact that in the entire absence of boron certain species, at least, are unable to develop properly. The necessary amount of boron is so small that most soils contain sufficient for the normal development of plants. During the last few years attention has been focused on certain obscure plant diseases for which no adequate explanation was forthcoming, and in many cases amelioration has been obtained by the application of boron compounds to the soil. Heart rot of sugar beet and brown heart of turnips are notable examples of this, and it is becoming a recognised practice to include a small quantity of boron compounds with the fertiliser, 12–20 lb. of borax per acre representing the safe limit, beyond which there is danger of injuring the plants by poisoning them. The great economic importance of this point has led to the establishment of a Boron Agricultural Bureau under the ægis of Borax Consolidated, Ltd., for the purpose of collecting and distributing information with regard to the use of borax for agricultural purposes. A word of warning may not be out of place. The beneficial results so far obtained by the application of borax as a specific against certain plant diseases may lead to undue optimism, and to a tendency to attribute every obscure plant disease to lack of boron, without adequate inquiry. The necessity for continued research must be emphasised, as it seems possible that the correct use of various 'minor' elements may lead to definite and valuable progress in agricultural practice.

### Cotton Industry in Northern Nigeria

AN interesting account of the future possibilities of the cotton industry in Nigeria was given by Mr. G. Browne, manager of the English Cotton Growing Corporation's Seed Farm in Northern Nigeria, at a recent meeting of the Administrative Council. The farm was started ten years ago, and has been chiefly occupied with testing out new strains of cotton prior to their distribution to the native farmers. In addition, a study has been made of intercropping with some plant other than cotton, the evidence going to show that better results are secured if two crops follow each other instead of being grown almost simultaneously. The question of the maintenance of fertility inevitably arises with this practice, and as green manuring proved unsuccessful, an entirely new method, namely, the introduction of cattle, was tried. At first high mortality rates occurred, due partly to tsetse fly trouble and partly to lack of experience as to the conditions under which cattle can be kept in good health in this district. Now, however, that the preliminary difficulties have been overcome by bush clearance and regular use of dip, etc., the cattle are already playing an important part in the agriculture of Northern Nigeria, and a new era of expansion seems probable. New implements, notably a steel plough, have also been introduced, and further, the Corporation is hoping, by the example of its own farm as well as by other means, to aid in this future development of the agricultural industry in Northern Nigeria, of which an increased output of cotton should be an outstanding result.

### Dialling Ships at Sea

WHEN the radio telephone was first applied to ships at sea about 1929, the ship receivers, connected either to a loud speaker or an operator's headset, were always 'on the air' and thus heard all calls. Stations were called by name, and all other stations listening on the same frequency would hear the call. With the increasing use of ship to shore radio service, a method of signalling one ship only became highly desirable, as this would obviate the necessity of keeping the loud speakers or telephone receivers 'on the air' all the time. In the *Bell Laboratories Record* of April a method of doing this is described. With this system, each ship has a three digit number assigned to it. When the operator at the telephone switchboard wishes to place a call, he merely dials the number of the ship wanted. This sends out a series of tone pulses which are received by all the ships within range. The called ship is the only one that receives an audible signal. On this ship a telephone bell rings and the operator picks his handset off the hook and replies in the usual way. When a call is answered, the handset is removed from its switchhook, thus operating the transfer relay. This removes the selector set from the radio receiver and connects the telephone receiver in its place. It also stops the bell ringing. When the telephone conversation is finished, the handset is returned to its hook and this releases the relay. The signal receiving set is automatically reconnected in preparation for receiving calls. This system is now being used by a number of coasting and harbour ships in America, but it promises to become applicable to a much wider field.

### Meteorology and the Sea Service

THE *Marine Observer* of April (13, No. 122) contains an article by Capt. L. A. Brooke-Smith, superintendent of the Marine Division of the Meteorological Office, Air Ministry, entitled "Observation and Weather Forecasting and Some of their Bearings on the Sea Service". The author comments on the great improvement in accuracy of observations of barometric pressure at sea since the Great War, and attributes this to the growing realisation on the part of ships' officers that weather forecasting is not only possible by a few specially trained meteorologists in observatories ashore, and to the increasingly

successful efforts in this direction that have resulted from that realisation. It fell to Capt. Brooke-Smith to explain to a committee of the Chamber of Shipping of the United Kingdom in 1921 some of the advantages which might accrue to navigation from the more general use of reliable thermometers as well as reliable barometers, and the report of that committee to the Chamber of Shipping included recommendations in respect to both these items. Apart from their value in forecasting, reliable measurements of atmospheric pressure at sea should eventually become important for pilots of aircraft when far from land, who will rely on them for obtaining correct indications of height from their altimeters, and for that purpose will have to obtain them by wireless from ships.

AN equal improvement in thermometers, Capt. Brooke-Smith states, has not yet taken place. He points out, however, that the information about temperature required at sea can generally be obtained from the broadcasts made on 2100 metres wave-length by British *A* class selected ships, which broadcasts have a range of 1,500 miles; such ships are to be found on all main trade routes, and all are equipped with thermometers certified by the National Physical Laboratory and exposed in Meteorological Office screens. The thermometers on such ships, when the ship is in port, afford a means whereby, through the courtesy of the captain, other ships may test their own thermometers and ascertain their accuracy. In answer to the frequently made suggestion that more British merchant ships should be equipped with instruments provided through the Meteorological Office, Capt. Brooke-Smith points out that the existing meteorological personnel at the ports is not adequate for dealing with such an increase, which would also throw excessive extra work on the divisions of the Meteorological Office concerned with maintaining the marine meteorological equipment, that is, the marine and instrument divisions.

### Sixteenth Century Central Europeans in England

IN the *Matice Moravská* (Brno, Czechoslovakia), Prof. O. Odložilík has just published the results of extensive researches among documents and manuscripts from British libraries and those in Holland and central Europe, under the title "Visits from Bohemia and Moravia to England, 1563–1620". He shows how scholars in Britain and the remoter parts of the Continent managed to keep in touch with each other's discoveries, views and writings. This contact was as strong between men of science (astronomers, mathematicians and others) as it was between theologians or historians. The period under review preceded the influx of refugees from the Thirty Years' War, but the question whether Komenský (Comenius) visited England in 1613 (that is, when he was only twenty-one years of age) is again raised. Whilst it is extremely unlikely that the great educationist did come to England prior to 1641, it is clear that many Bohemian and Moravian students and savants (including Peter Vok and Thaddeus Hajek) visited Oxford and Cambridge, and made contact with such sixteenth century Englishmen as Dr. John Dee, Francis Bacon, Sir Philip Sidney, Lord Burghley and the Earl of Essex. Some, like Charles of Žerotin, acted as diplomats between Bohemian monarchs and the British Crown at this period when culture and science began to flourish again after the Dark Ages.

### Flashes of Lightning

ACCORDING to a message from Science Service, flashes of lightning photographed by a cine-camera by J. W. Beams, L. B. Snoddy and E. J. Workman, of the Universities of New Mexico and Virginia, were shown at the recent meeting of the American Physical Society. The progress of the flash was shown to be similar to that of a nail gradually piercing a wooden board step by step under the successive blows of a hammer. Their cameras showed that the first flash extended halfway from the cloud to the earth. A second one followed the path of the first but went six tenths of the way, while a third travelled seven tenths of the distance. The fourth flash reached all the way and struck the earth. Four other flashes from the cloud to the earth followed at short intervals of approximately one hundredth of a second.

### Institution of Gas Engineers

AT the seventy-third annual general meeting of the Institution of Gas Engineers which opened in London on May 26 the following medals were presented: Institution Gold Medal, to George Dixon, for a paper on "Problems and Answers in the Reconstruction of Manufacturing and Distribution Plant, Nottingham"; H. E. Jones London Medal, to W. L. Boon, for a paper on "The Preparation, Marketing and Utilization of Coke"; Institution Silver Medal, to T. P. Ridley, for a paper on "Gas Tariffs"; Institution Bronze Medal, to William Hodkinson, for a paper on "Benzole Recovery and the Production of Motor Benzole". Mr. Stephen Lacey, controller of gas sales, Gas Light and Coke Company, London, was elected president of the Institution for the year 1936–37, and Mr. H. C. Smith, chief engineer, Tottenham and District Gas Company, and Mr. Robert Robertson, engineer and works manager, Bristol Gas Company, were elected vice-presidents.

### South African Association for the Advancement of Science

UNDER the presidency of His Excellency the Right Hon. the Earl of Clarendon, Governor General of the Union of South Africa, the South African Association for the Advancement of Science will hold its thirty-fourth annual session on October 5–10 in Johannesburg. It is noteworthy that the meeting coincides with the celebrations connected with the jubilee (fifty years) of Johannesburg, and with the holding there of the Empire Exhibition. Sectional presidents are: A, Dr. E. J. Hamlin, city engineer, Johannesburg ("The Researches of a City Engineer's Department"); B, Prof. E. D. Mountain, professor of geology and mineralogy at Rhodes University College,

Grahamstown, C.P. ("Minerals"); C, Prof. John Phillips, professor of botany in the University of the Witwatersrand ("Biology and Industry: with special reference to Plant Biology and the Mining Industry"); D, Dr. R. Bigalke ("The Naturalisation of Wild Animals with special reference to South Africa"); E, Prof. M. R. Drennan, professor of anatomy in the University of Cape Town ("Human Growth and Differentiation"); F, Dr. I. D. MacCrone, lecturer in psychology in the University of the Witwatersrand ("The Problem of Race Differences"). Prof. L. Fouché, professor of history in the University of the Witwatersrand, is to deliver a public evening lecture on the history of the Witwatersrand. Symposia have been arranged in the various sections, while demonstrations and excursions are included in the programme. A cordial invitation to attend the meetings is extended to visitors from overseas who are connected with, or interested in, scientific pursuits; visiting scientific workers will be made honorary members for the session.

*Announcements*

THE Government of the Spanish Republic has conferred the decoration of 'Comendador de la Orden de la República' upon Sir Henry Wellcome, the founder of the Wellcome Research Institution, London, in recognition of his outstanding services to Spanish interests.

AN exhibition of photographs organised by the American Institute for Persian Art and Archæology, including photographs representative of the latest work of the Institute's architectural survey, will be held at the Royal Institute of British Architects on June 9–26. The exhibition will be opened at 3.30 p.m. on June 9 by His Excellency Hussein Ala, the Iranian Minister in London.

DR. ENID CHARLES, of the Department of Social Biology of the London School of Economics, will open a discussion on "Population Trends in Relation to the Housing Problem" at the Guildhouse, Eccleston Square, Victoria (Berwick Street entrance), on Tuesday, June 2, at 7.30 p.m. The discussion has been arranged by the Research Co-ordination Committee in conjunction with the Engineers' Study Group. Those wishing to attend should notify the honorary secretary, Research Co-ordination Committee, Hazlitt House, Southampton Buildings, W.C.2 (Tel.: Holborn 1068). The discussion is part of a concerted plan to approach the housing problem from various angles: sociological, architectural, health, engineering and financial.

THE German Statistical Society will hold its annual meeting at Brunswick on June 25.

THE Chancellor of the German Reich has awarded the shield of nobility to Prof. Gustav Tammann, professor of physical chemistry at Göttingen, and the Goethe Medal to Dr. Reinhold Schmaltz, professor of anatomy, embryology and histology at Berlin.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A head of the Building Department in the Gloucester Technical College—The Principal (June 3).

A head of the Engineering Department in the Shrewsbury Technical College—The Secretary for Education, County Buildings, Shrewsbury (June 3).

A University demonstrator in physics in the University of Cambridge—Dr. R. G. W. Norrish, University Chemical Department, Cambridge (June 4).

An assistant lecturer in chemistry in the Robert Gordon's Technical College, Aberdeen—The Registrar (June 5).

A demonstrator in anatomy in the University of Sheffield—The Registrar (June 6).

A lecturer in civil and mechanical engineering in the Woolwich Polytechnic, London, S.E.18—The Secretary (June 6).

A principal of the Norwich Technical College—The Director of Education, City Education Offices, Norwich (June 8).

An electrical engineer in the Armaments Inspection Department, Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London (June 9).

A demonstrator in biology in the London (Royal Free Hospital) School of Medicine for Women—The Secretary, 8 Hunter Street, Brunswick Square, W.C.1 (June 12).

A lecturer in physiology in the Chelsea Polytechnic, London, S.W.3—The Principal (June 12).

A demonstrator in mathematics in the City and Guilds College, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7—The Secretary (June 19).

An assistant lecturer in mechanical engineering in the Municipal College of Technology, Manchester—The Registrar (June 29).

An instructor in mechanical and electrical engineering in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, 429 Strand, W.C.2 (Aug. 21).

A lecturer in geography and nature study in the Bedford Froebel Training College—The Principal, 14 The Crescent, Bedford.

A lecturer in physics in the Heriot-Watt College, Edinburgh—The Principal.

A lecturer in geography in St. Peter's College, Peterborough—The Principal.

A professor of physics in Canterbury University College, Christchurch, New Zealand—The Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

A lecturer in geography in the University of Reading—The Registrar.

A professor of mathematics and a professor of education in University College, Cork—The Secretary.

A district engineer in the Public Works Department of the Sudan Government—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1.

A senior engineer in the Equipment Department of the B.B.C.—The Engineering Establishment Officer, Broadcasting House, London, W.1.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 910.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Metabolism of Cold-Blooded Animals in Different Latitudes

WHEN the oxygen consumption of a species of poikilothermal animals is measured at various temperatures, it is found that more oxygen is used at high temperatures than at low. This is partly because the movements of the animals are greater at higher temperatures, and partly owing to a greater non-locomotory oxygen consumption when the temperature is raised. Instead, now, of a single species in a given locality, consider two nearly related stenothermal species of marine cold-blooded animals, one living in cold seas, the other confined to warmer waters. It is a common observation that species of poikilothermal animals in cold climates are as active as related species in hot climates. But what are the oxygen and food requirements of two such species? This question seems never to have been studied.

I have compared a number of species of arctic or northern marine invertebrates with nearly related species from the English Channel. The oxygen consumption of these animals has been studied, and the rates of respiratory movements of crustaceans and of ciliary movement in scallops have been measured, at various temperatures.

The cold-water animals were investigated at the Kristineberg Zoological Station on the west coast of Sweden. There the lower water of the Gullmar Fjord, from a depth of 60 metres to the bottom at 140 metres, has a salinity of 33–34 per thousand, an annual temperature varying only from 5° to 7°, and a population of arctic and northern species. The Station has a circulation of cold sea-water in which these animals can be kept alive. The English animals were taken at Plymouth, where they live in water having a normal minimum temperature of 7°–8° and a normal maximum of 14°–15°. The Plymouth animals were studied at Birmingham in sea-water of 35 per thousand salinity.

The *oxygen consumptions* were compared in the following pairs of species:

| | Kristineberg | Plymouth |
|---|---|---|
| (1) | *Stichopus tremulus* | *Holothuria forskali* |
| (2) | *Ophiura sarsi* | *O. texturata* |
| (3) | *Antedon petasus* | *A. bifida* |
| (4) | *Phascolosoma margaritaceum* | *P. elongatum* |
| (5) | *Pandalus borealis* | *P. montagui* |
| (6) | *Spirontocaris securifrons* | *S. cranchi* |
| (7) | *Pontophilus norvegicus* | *P. spinosus* |

In all seven cases, the oxygen consumptions of the Kristineberg and of the Plymouth species, each at two temperatures, can be represented respectively by curves similar to $k$ and $p_1$ (Fig. 1): this means that in every pair of species the oxygen intake of the warmer-water form is higher than that of the colder-water species, just as if a single species, in one locality, had been studied over the whole range of temperatures. Since the locomotory activities of the warmer- and colder-water species are about the same, I suggest that the oxygen required for locomotion is approximately the same in each, but that the non-locomotory metabolism is higher in the warmer-water species.

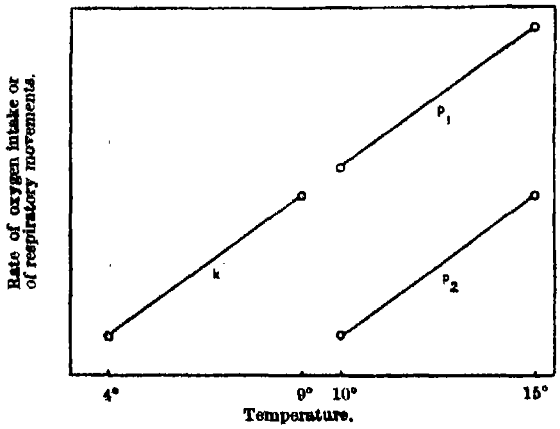



FIG. 1.

A comparison of the rates of *ciliary movement* in the gills of the scallops *Chlamys septemradiata* (Kristineberg) and *C. varia* (Plymouth) again gave curves like $k$ and $p_1$.

But the *respiratory movements* of the Crustacea gave a different result. The rates of scaphognathite movements were compared in prawns (the two species of *Pandalus* and the two species of *Spirontocaris*), and the rates of the maxillepede epipodites in a pair of *Apseudes* species (*A. spinosus*, Kristineberg, and *A. latreillei*, Plymouth). In each of these three pairs the results gave curve $k$ for the Kristineberg species and $p_2$ for the Plymouth species. It is clear that the respiratory movements of the warmer-water species were no faster than those of the colder-water forms, each at the usual sea temperatures at which the animals live. The rates of respiratory movements seem thus to correspond to the similar locomotory oxygen consumption postulated above.

In addition to comparing stenothermal northern with English species, I have commenced comparisons between members of single eurythermal species living in different latitudes. Here the preliminary results show adaptations within single species. The rates of scaphognathite-beat of a certain species of prawns living both at Plymouth and at Kristineberg give curves $k$ and $p_2$ at these two places respectively: the rate at Plymouth at 16° is no faster than that at Kristineberg at 6°. This concords with the work of Mayer[1], who showed that the

medusa *Aurelia aurita* is acclimatised to different latitudes: in Florida its optimum temperature for pulsation is 29°, whereas this temperature is fatal to members of the same species in Nova Scotia.

The results summarised here will be published in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.

Zoology Department,
University, Birmingham.
May 6.

A. G. Mayer, *Pap. Tortugas Lab.*, 6, 3 (1914).

## Interpretation of Shankland's Experiment

THE experimental results of Shankland[1] are in contradiction with the accepted theory of the Compton effect, in particular with the idea of detailed conservation of energy and momentum. If we accept his evidence, and if we assume that, in this process, energy and momentum are not given out in some unknown form, we have to conclude that energy and momentum are not conserved. As Dirac pointed out recently[2], Shankland's result would be compatible with the point of view of Bohr, Kramers and Slater. I would like, however, to direct attention to the fact that this point of view by no means affords the only plausible interpretation of the experiment.

To make this clear, it is useful to divide the predictions of the current theory into the following statements:

(*a*) Supposing the frequency and direction of the incident radiation to be given, the radiation scattered through an angle $\theta$ will have a definite frequency $\nu(\theta)$. The recoil electrons emitted at an angle $\varphi$ with the incident beam will have a definite energy, $E(\varphi)$.

(*b*) Simultaneously with each recoil electron, there appears one quantum of the scattered radiation, and vice versa.

(*c*) Between the direction of emission of a recoil electron and the simultaneous quantum of scattered radiation there is, again for given direction and frequency of the incident radiation, an unambiguous connexion: the two directions lie in one plane through the direction of incidence, and their angles $\theta$ and $\varphi$ are definite functions of each other.

Statement (*a*) is very accurately confirmed in the X-ray region, but I am not aware of an equally exact confirmation for energies as high as those used by Shankland. This point is of importance, as the fact (*a*) is the only reason for assuming that no energy is given out in a form unknown at present.

Statement (*b*) was, for X-rays, subject to a test by Bothe and Geiger[3], who found a positive result.

Shankland's experiment is a test for (*b*) and (*c*) together, for, as distinct from Bothe-Geiger, his counters subtend small solid angles with the scatterer, and if (*b*) would hold but not (*c*), the number of coinciding pairs that would happen to pass his counters would be too small to be detected. If we accept his evidence, we are then forced to abandon either (*c*), or (*b*) and (*c*) together. (One cannot, of course, retain (*c*) without (*b*), as without (*b*) recoil electrons and secondary quanta are not connected in pairs.)

(i) The point of view of Bohr-Kramers-Slater and Dirac would imply that (*b*) and (*c*) have to be abandoned. This would necessarily imply that the Bothe-Geiger experiment was erroneous. On that view, the photon does not exist in the corpuscular sense of the current theory.

An alternative—and, it seems to me, equally plausible possibility—is that (*b*) still holds; that is, that there *is* a secondary photon for each recoil electron, but that their directions do not obey the relations required by the conservation laws.

(ii) One may either believe that (*c*) breaks down for *any* frequency of the incident radiation, just as Bohr-Kramers-Slater require (*b*) to break down for all frequencies.

(iii) Alternatively, one may believe that (*c*) holds, at least approximately, for small frequencies, and that deviations from it become appreciable only for photon energies of the order of a million volts. The latter alternative would, on the existing evidence, give us the freedom to abandon also the exact validity of (*a*) for high frequencies. This would, in many ways, seem more satisfactory, for (*a*) is the very direct result of applying the conservation laws. It seems therefore artificial to maintain it where the conservation laws fail. Together with (*a*), the statistical conservation of energy would fall. That, too, seems satisfactory, once detailed conservation has been abandoned.

Again, if we abandon both (*a*) and (*c*) for high energies, there would be a close analogy between the two phenomena in which an apparent non-conservation has been observed, namely, the Compton effect and the continuous $\beta$-spectrum, while on the point of view of Bohr-Kramers-Slater or on the assumption (ii) above, these must be widely different phenomena.

A decision between (i), (ii) and (iii) (and possibly other interpretations) can, of course, only be made by further experiments, and a theoretical discussion of advantages and disadvantages of (ii) and (iii) as compared to (i) would, at the present stage, be idle. But their possibility should be kept in mind in order to carry out and discuss such experiments without being biased by one particular non-conservation theory.

R. PEIERLS.

Royal Society Mond Laboratory,
Cambridge.
April 23.

[1] *Phys. Rev.*, 49, 8 (1936).
[2] NATURE, 137, 298 (Feb. 22, 1936).
[3] *Z. Phys.*, 32, 639 (1925).

## Colour of the Luminous Background of the Extra-Galactic Nebulæ

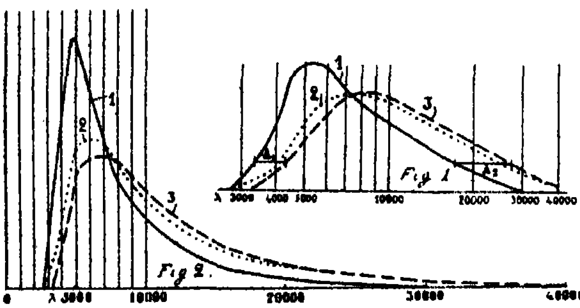
ACCORDING to Milne, the multitude of the distant galaxies form a continuous luminous background. It is interesting to investigate what its colour should be. By Hubble's law, the spectra of the galaxies are shifted towards the red. It is easy to calculate the integral colour of the background if we adopt Milne's view that the galaxies are really receding. Then the light of a galaxy is shifted towards the red according to Doppler's law. The intensity from a receding nebula is less than it would be if the nebula were motionless at the same distance. Indeed, a quantum of light if shifted to the red has less energy than the original quantum; in addition, when a source of light is receding, its quanta fall upon the observer less frequently than they would if the source were motionless. Under the combined action of both causes the intensity is diminished doubly.

Using Milne's formula for this effect (it follows from the electrodynamics of special relativity too), and his picture of the universe, I have calculated the integral spectrum of the background. In such calculations it is more convenient to represent the intensity of spectrum not as a function of the wave-length $\lambda$, but as a function of $\ln\lambda$, for then the Doppler effect displaces the curve of the spectrum as a whole, and does not distort it. If $F(\ln\lambda)$ is the spectrum of the sun (that is, of a motionless galaxy), then the spectrum of the background of the galaxies which have velocities greater than $V$ is

$$\int_{x_0}^{\infty}\left(\frac{2x}{e^{2x}-1}\right)^2 F(\ln\lambda - x)\,dx,$$

where $x_0$ is $\frac{1}{2}\ln\frac{1+V}{1-V}$.

By a very *rough* graphical integration I have found this integral. The result is shown in Fig. 1. The abscissæ are $\ln\lambda$. Curve 1 is the solar spectrum, Curve 2 is the spectrum of the light from all the galaxies, and Curve 3 is the spectrum of the background of the galaxies which are invisible separately through a telescope. The mean shift of this spectrum $(\Delta_1 + \Delta_2)/2$ is about one half of the length of the visible spectrum. The integral areas of the three curves are made equal. Fig. 2 shows the same spectra drawn as usually, the abscissæ being $\lambda$, and not $\ln\lambda$.




We see that more than a half of the radiation with which the universe is filled is infra-red. To a most sensitive eye the background of the galaxies would appear as dark red.

In the calculations, I did not allow for the absorption of light when a galaxy stands in front of another. This absorption must somewhat diminish the redness of the background of the extra-galactic nebulæ.

M. LEONTOVSKI.

Astronomical Observatory,
University of Leningrad,
U.S.S.R.
March 22.

### Cross-Section Measurements with Slow Neutrons of Different Velocities

IN recent experiments[1] we got information about the relative position of the resonance levels for neutron capture in certain nuclei. The levels could be arranged as follows:

$$\text{Br (18 min.)} > \text{I} > \text{Ag (22 sec.)} > \text{Rh (45 sec.)} \sim \text{In} \sim \text{Ir}:$$

the level of Br having the highest, those of Rh, In and Ir the lowest energy.

This relation permits a qualitative investigation of the dependence of cross-sections for diffusion and capture of neutrons on the velocity. In connexion with a letter by Frisch and Placzek[2], who assume the cross-section for neutron capture by boron to be inversely proportional to the neutron velocity, we wish to communicate some of our results.

We found that, within the whole range from neutrons of thermal velocity up to the resonance level of Br (18 min.), the cross-section for neutron capture by boron decreases with increasing energy of the neutrons. Though we can give no proof that the cross-section is really proportional to $1/v$ ($v$ being the velocity of the neutrons), our experiments show at least that no discontinuities occur in this range of velocity. The absorption of neutrons by boron can therefore certainly be used to determine qualitatively their energy.

Frisch and Placzek assumed an especially simple cross-section function for boron in consequence of the character of neutron capture followed by disintegration into two charged particles. A similar process is that of neutron capture by $^{6}_{3}$Li. We therefore thought that, if this reasoning was correct, the cross-section for neutron capture ought also to depend in the same way on the velocity, for lithium as for boron. In this case the ratio of those two cross-sections would be independent on the velocity.

The results of some measurements with absorbers of lithium and boron are given in the accompanying table; $\mu_{Li}$ and $\mu_B$ indicate the massive absorption coefficients of lithium and boron for neutrons. Assuming the $1/v$ law for the absorption by boron we obtain the energies indicated in the last column. The experiments have been carried out in the usual way: cadmium was used to separate the neutrons of thermal energy from those, belonging to the different resonance levels, which were selected by using the respective elements as indicators.

| Energy of neutrons | $\mu_B$ | $\mu_{Li}$ | $\mu_B/\mu_{Li}$ | Volts |
|---|---|---|---|---|
| Resonance level of | | | | |
| Br (18 min.) | 0·8 | 0·2 | 4·0 ± 1 | 56 |
| I | 1·5 | 0·4 | 3·8 ± 0·6 | 16 |
| Ag (22 sec.) | 3·4 | 0·3 | 11·3 ± 1·5 | 3 |
| Rh (45 sec.) | 6·3 | 0·8 | 8·0 ± 1·5 | 1 |
| Thermal energy | 30 | 3·0 | 10·0 ± 1·5 | 0·04 |

These results seem to show that for energies above the resonance level of Ag (22 sec.) the cross-section functions for capture by lithium and boron behave differently. But this deviation seems due to scattering of neutrons by the lithium absorber.

A series of experiments showed that the cross-section for back diffusion of neutrons by carbon was constant within the whole range between the resonance level of Br (18 min.) and thermal energy. (This result agrees with the results of Pontecorvo and Wick[3].)

A sheet of cadmium (0·5 gm./cm.$^2$) absorbed 95 per cent of the artificial radioactivity created by slow neutrons in dysprosium[4]. This indicates that dysprosium has either no resonance level for the capture of slow neutrons, or a resonance level the energy of which is lower than the upper limit for strong absorption by cadmium. Experiments with cadmium absorbers and boron absorbers of different thicknesses seem to prove the latter alternative; these experiments are being continued.

We found in general that the cross-sections for resonance neutron capture and for capture of thermal neutrons are largest for those nuclei the resonance levels of which have the lowest energy.

*Added in proof:* Determination of the breadth of the level for Ag (22 sec.). A solution of $AgNO_3$ and an equivalent solution of $HNO_3$ were used alternatively for the slowing down of neutrons in a vessel, the dimensions of which were large, compared with the mean free path of neutrons belonging to the level of Ag (22 sec.). Comparing the intensities of silver and of rhodium resonance neutrons in these two cases, we observed that $AgNO_3$ (1·0 gm./cm.²) reduced the intensity of the neutrons belonging to the level Ag (22 sec.) to 46 per cent, those belonging to the level Rh (45 sec.) only to 84 per cent of the intensity obtained in $HNO_3$. Since the neutrons of the rhodium level are slower, this shows that only every fourth neutron becomes a silver neutron whilst being slowed down. The neutrons are not slowed down continuously, they lose on the average half their energy at every shock with a free proton. A resonance level is therefore only passed by all neutrons when its breadth is at least half its energy. Our result shows that three quarters of the neutrons jump over the silver level. Its breadth must therefore be 1/8 of its energy or 0·4 volt. Of course 0·4 volt is at the same time the maximum breadth of the γ-ray of some millions of volts which is emitted when the neutron is captured.

We wish to thank Mr. P. Savitch for his efficient help and for interesting discussions.

HANS VON HALBAN, jun.
PETER PREISWERK.

Institut du Radium,
Laboratoire Curie,
Paris.
April 3.

[1] P. Preiswerk and H. von Halban, jun., *C.R.*, **202**, 840 (1936).
[2] O. R. Frisch and G. Placzek, NATURE, **137**, 357 (1936).
[3] Pontecorvo and Wick, *La Ricerca Scientifica* ii, 2, n.3–4.
[4] G. v. Hevesy and H. Levi, NATURE, **136**, 103 (1936).

## Structure of Neutrons and β-Disintegration

IT seems that an electron does not exist as a separate dynamical entity in a neutron. We assume, accordingly, that when a neutron is formed from a proton and an electron, the excess of energy of the particles is transformed into rest mass, energy and momentum being conserved.

If **u**, **V**, **V′** are the velocities of an electron, proton and neutron, and $m$, $M$, $M'$ their respective masses, then

$$\frac{m\mathbf{u}}{\sqrt{(1-u^2/c^2)}} + \frac{M\mathbf{V}}{\sqrt{(1-V^2/c^2)}} = \frac{M'\mathbf{V}'}{\sqrt{(1-V'^2/c^2)}} + 2m\vec{c},$$

$$\frac{m}{\sqrt{(1-u^2/c^2)}} + \frac{M}{\sqrt{(1-V^2/c^2)}} = \frac{M'}{\sqrt{(1-V'^2/c^2)}} + 2m;$$

where $2mc^2$ is the binding energy.

Neglecting $V$, we find:

$$M' \simeq M - m + \left[\frac{m}{\sqrt{(1-u^2/c^2)}} - m\right];$$

the term in square brackets would correspond to the neutrino.

It would seem that the kinetic energy of β-rays, emitted at disintegration, is acquired at the expense of the rest mass of a neutron; the difference between the masses of neutrons should, accordingly, be of the order of magnitude of the energy of β-rays.

Several values have been found for the mass of a neutron. For example, Chadwick and Curie-Joliot obtained 1·0067 and 1·010 respectively (difference about $6mc^2$ or $3 \times 10^6$ volts). If the difference between the masses is genuine, and not due merely to experimental errors, it could be explained by the structure of neutrons suggested. It is not necessary to assume that the electron spin is destroyed at the formation of a neutron; it might remain unobservable.

A classical picture of a neutron would be a rotating 'sphere' smoothly connected with a 'gyroscope' so that the spin of the latter remains uninfluenced by the external field.

D. MEKSYN.

Department of Mathematics,
Imperial College of Science,
S.W.7.

## Thermal Decomposition of Acetaldehyde and Ethylene Oxides: Existence of Short-Lived Intermediates

THE writer of the section of the Annual Reports of the Chemical Society, which has just been published, tells us that the results of the investigations of Hinshelwood and his co-workers on one hand, and of myself and my co-workers on the other, lead to the conclusion that the decomposition of acetaldehyde is influenced by chain mechanism at low temperatures but not at high temperatures. Whether the conclusion could justly be drawn from the published information available to the writer of the section of the Report is a matter of opinion; but it appears to be negatived by the results of more recent work.

Our work shows that, considered from the point of view of organic chemistry, when acetaldehyde is heated to temperatures between 360° and 500°, and over a wide range of concentrations, decomposition follows two alternative courses, represented by the equations:

$$(1)\ C_2H_4O = CH_4 + CO,$$

$$\text{or}\ (2)\ 2C_2H_4O = CH_3{-}CH{=}CH{-}CHO + H_2O,$$

$$CH_3{-}CH{=}CH{-}CHO = CH_3{-}CH{=}CH_2 + CO.$$

The former process is dominant in an unpacked tube, though some propylene is always formed; but the second process is dominant in a packed tube. It may be added that the propylene always undergoes some condensation, with the result that some 6-carbon hydrocarbon is produced, together with more complex products.

Now it would appear at first sight that we are dealing with two quite independent processes, one taking place on the surface, and the other in the gas phase; and as the volume change accompanying the second set of changes is relatively only a little less than that accompanying the simpler process represented by the first equation, the extent to which each of the processes takes place cannot be determined from the results of pressure measurements. Detailed analytical methods do, however, enable us to follow the processes exactly, and when this method is adopted we arrive at a very interesting conclusion.

While packing a reaction tube results in the slowing down of the first process and accelerating the second, it is found that the total rate of decomposition of the acetaldehyde is altogether independent of the nature or dimensions of the reaction tube. One must conclude therefore that the first stage in the process of decomposition, over the range of temperature

referred to, involves the formation of one single type of primary nucleus. The simplest explanation of the result which we have arrived at involves the assumption of the existence of a short-lived intermediate, the transition process involving the passage over a potential barrier, such that the change,

primary nucleus → short-lived intermediate,

is practically irreversible. The short-lived intermediate may then either undergo change in the gas phase within average time $\Delta t$, when the result is represented by equation (1), unless within this period it strikes a surface, when it undergoes, or takes part in, the changes represented by the second set of equations.

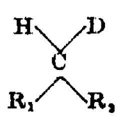
We find that at all concentrations, and at all temperatures at which we have carried out experiments, the rates of decomposition both of acetaldehyde and of ethylene oxide are accelerated initially, the acceleration being more marked in the case of ethylene oxide, which exhibits an induction period. From the consideration of thermodynamic data, one would have anticipated that such a relationship would exist. However, the phenomenon of acceleration is so marked in the case of both compounds, and the primary energy changes are relatively so small, that one cannot escape the conclusion that the processes involved in the thermal decomposition of these compounds are very much more complex than has been suggested, and must be bound up with secondary changes, such as that involved in the formation of a short-lived intermediate, the existence of which is indicated by the results of our investigation. We specifically avoid the use of the term free radical in reference to these phenomena.

MORRIS W. TRAVERS.
R. V. SEDDON.

Chemistry Department,
University, Bristol.
May 6.

## Reduction of γ-Phenyl-α-Methylallylalcohol with Deuterium

AN attempt to prepare a compound containing an asymmetric carbon atom of the form

 . . . . (1)

in an optically active state has been based upon the experiment of Kenyon and Partridge previously published[1], in which an asymmetric synthesis is achieved by means of the following series of reactions:

$$CH_3\overset{*}{C}HOH.CH{=}CHPh \quad \ldots\ldots \quad (2)$$
$$\downarrow$$
$$CH_3\overset{*}{C}HOH.\overset{*}{C}HBr.\overset{*}{C}HBrPh \quad \ldots\ldots \quad (3)$$
$$\downarrow$$
$$CH_3CO.\overset{*}{C}HBr.\overset{*}{C}HBrPh \quad \ldots\ldots \quad (4)$$

*d*-γ-phenyl-α-methylallylalcohol $[\alpha]^{18°}_{5893} = +22{\cdot}0$, $c = 5$, $l = 2$, in carbon disulphide[2] on reduction with hydrogen at two atmospheres in the presence of a platinum oxide catalyst prepared according to the method of Adams, Voorhees and Shreiner[3] in ether solution gave methyl-β-phenylethylcarbinol ($\alpha^{18°}_{5893} - 3{\cdot}32$; $\alpha^{18°}_{5780} - 3{\cdot}56$; $\alpha^{18°}_{5461} - 4{\cdot}01$; $\alpha^{18°}_{4358} - 6{\cdot}48$; ($l = 0{\cdot}25$); b.p. 127° C./18 mm.; $\mu^{20}_{D} = 1{\cdot}5167$); while fully active methyl-β-phenylethylcarbinol prepared by direct resolution[4] has ($\alpha^{18°}_{5893} - 3{\cdot}43$, $\alpha^{18°}_{5461} - 4{\cdot}10$, $\alpha^{18°}_{4358} - 6{\cdot}85$; ($l = 0{\cdot}25$); $\mu^{20}_{D} = 1{\cdot}5168$).

Reduction of the same batch of alcohol with deuterium prepared from 99 per cent heavy water by decomposition over iron[5] at 600° C. is complete within one hour and results in a saturated alcohol: $\alpha^{18°}_{5893} - 3{\cdot}44$, $\alpha^{18°}_{5780} - 3{\cdot}65$, $\alpha^{18°}_{5461} - 4{\cdot}11$, $\alpha^{18°}_{4358} - 6{\cdot}74$ ($l = 0{\cdot}25$); b.p. = 127° C./18 mm.; $\mu^{20}_{D} = 1{\cdot}5168$. This on oxidation with chromic acid in acetic acid at 75°–80° C. gave methyl-αβ-dideutero-β-phenylethyl ketone, which after purification by preparation of the crystalline bisulphite compound, and subsequent decomposition with sodium carbonate solution, had: $\alpha = \pm 0$; b.p. 232° C. (Beilstein 235°–236° C.); Found C = 80·3 per cent, H = 8·84 per cent; $C_{10}(H_{10}D_2)O$ requires C = 80·0 per cent; H = 9·33 per cent.

This result appears to show that if the addition of deuterium to (2) takes place unsymmetrically as in the case of bromine addition, an asymmetric system of the type (1) has no optical rotatory power. If optical activity is associated with some form of unsymmetrical electrical distribution around the asymmetric atom, then it would appear that the fields associated with light and heavy hydrogen in combination with carbon are approximately equivalent.

The boiling point and refractive index appear to undergo no change when hydrogen is replaced by deuterium in these compounds.

In view of the fact that the absorption of deuterium was half completed in ten minutes, it is unlikely that any exchange reaction in the presence of the catalyst would materially affect the result.

We wish to thank Dr. J. Kenyon for his kind interest in this work.

J. B. M. COPPOCK.
S. M. PARTRIDGE.

Battersea Polytechnic,
S.W.11.
March 27.

[1] Kenyon and Partridge, *Chem. and Ind.*, **55**, 81 (1936).
[2] Kenyon, Partridge and Phillips, *J. Chem. Soc.*, **85** (1936).
[3] Pickard and Kenyon, *J. Chem. Soc.*, **105**, 1125 (1914).
[4] Adams, Voorhees and Shreiner, "Organic Syntheses", **8**, 92.
[5] Coppock, *Trans. Faraday Soc.*, **31**, 913 (1935).

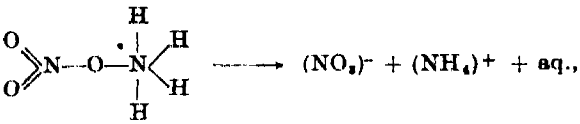
## Absorption Spectra and Linkage of Inorganic Salts in the Vapour State

IN continuation of earlier work[1] we have investigated the absorption spectrum of inorganic sulphates and of ammonium nitrate in the vapour state. The same method was employed, but that the $SO_2$ bands were used as indicator of decomposition of the sulphates. The observed maxima of selective absorption are as follows (in mμ): $H_2SO_4$ 262, $K_2SO_4$ 258, $Ag_2SO_4$ 265, and $ZnSO_4$ 269. The red wave limits are 285, 293, 300 and 294 mμ respectively.

The free sulphate ion absorbs only below 220 mμ, while dimethyl and diethyl sulphate possess a maximum of selective absorption at about 270 mμ in the liquid state[2]. The red wave limits observed in the vapour state agree fairly well with the energy of the dissociation process $SO_3 = SO_2 + O(^3P)$, and that observed in dilute aqueous solutions of alkali sulphates with that of the process $SO_4{}^{2-} = SO_3{}^{2-} + O(^3P)$. It

is concluded that inorganic sulphates are covalently bound in the vapour state.

Special interest is attached to the spectrum of ammonium nitrate in the vapour state. It exhibits a diffuse maximum at 262 mμ with a long wave limit at 299 mμ, and hence appears to be bound covalently in the vapour state, as are all the other inorganic nitrates investigated earlier. This indicates a structural formula such as



(vapour) (solution)

with five covalent bonds in the vapour state, in contradiction to the covalency maximum of four, introduced by Sidgwick on the basis of the octet theory.

A detailed report will be published in the *Proceedings of the Indian Academy of Sciences* (Bangalore).

M. ISRARUL HAQ.
R. SAMUEL.

Department of Physics,
Muslim University,
Aligarh.

[1] NATURE, 137, 496 (1936).
[2] S. M. Karim and R. Samuel, *Proc. Ind. Acad. Sci.* (Bangalore), 1, 398 (1934).

## Isotope Displacement in the Arc Spectrum of Platinum

WE have been engaged for some time upon the study of the fine structures of thirty-three lines of the arc spectrum of platinum in the region λλ 6800–4320. We find that the odd isotope, 195, has a nuclear spin of ½, and that all the terms observed by us exhibit regular even isotope displacement, the lightest isotope lying deepest. The approximate abundance ratios of the four observed isotopes, 198, 196, 195, 194, are 1 : 4 : 4 : 5. Jaeckel and Kopfermann[1] have just recently published fine structure measurements of 46 Pt I lines in the region λλ 5900–2350. They also find that the spin of 195 is ½ and report the values of the even isotope displacements in 27 terms. Eight of the lines measured by J. and K. are amongst those studied by us and both sets of measurements are in good agreement.

EVEN ISOTOPE DISPLACEMENTS IN THE PT I SPECTRUM

| Term | | Authors | J. and K. | Term | | Authors | J. and K. |
|---|---|---|---|---|---|---|---|
| $5d^8\,6s^2$ | $^3F_4$ | 199 | 205 | $5d^8\,6s6p$ | $^5D_4$ | ∼76 | 110 |
| | $^3F_2$ | 200 | 200 | | $^5G_5$ | 107 | 109 |
| | $^1G_4$ | 93 | | | $^5D_3$ | ∼45 | 85 |
| $5d^9\,6s$ | $^1D_2$ | 116 | 123 | | $^5G_6$ | 107 | |
| $5d^9\,6p$ | $^3P_2$ | 35 | 37 | | $D_1$ $(X_1)$ | 83 | 85 |
| | $^3F_3$ | 57 | 55 | | $D_2$ $(Y_2)$ | 50 | 47 |
| | $^3F_4$ | ∼15 | ∼40 | | $D_3$ $(Z_3)$ | ∼13 | 45 |
| $5d^9\,7s$ | $^3D_3$ | ∼23 | 15 | | $^5F_5$ | 109 | 116 |
| | $^3D_2$ | 2 | 12 | | $^5F_4$ | 107 | |
| | $E_2$ | ∼0 | | | $^5D_2$ | ∼25 | ∼50 |
| | $M_2$ | 107 | | | $D_2$ $(13_2)$ | 107 | |
| $5d^8\,6s7s$ | $^5F_5$ | 107 | ∼100 | | $D_2$ $(17_2)$ | 107 | |
| | $^5F_4$ | 107 | ∼100 | | | | |

The terms observed by J. and K. belong to the $5d^9 6s$, $5d^8 6s^2$, $5d^8 6s6p$, $5d^9 7s$, $5d^9 6p$, $5d^8 6s7s$ and $5d^{10}$ electron configurations, and from already established data on even isotope displacement they justifiably assume the displacement in $5d^{10}$ to be approximately zero. This enables absolute displacements to be determined.

We have measured even isotope displacement in 25 terms and obtained relative values based upon the assumption that the displacement in $5d^9 7s\,^3D_3$ was zero. The measurements of J. and K. show that a slight adjustment is necessary for they give 12 cm.$^{-1}$ × $10^{-3}$ as the absolute displacement for this term. This absolute value is adopted by us and we find that our displacements are in very good general agreement with those of J. and K. The important confirmatory fact that there is agreement between both sets of *relative* displacements is, of course, independent of the slight adjustment.

The accompanying table gives a comparison of our values with those of J. and K. Displacements are given in cm.$^{-1}$ × $10^{-3}$, and in all cases the three even isotopes are approximately equidistant, 194 being deepest.

Attention may be directed to the fact that Pt 195 (spin ½) is an atom with an odd nuclear neutron, and, as has been shown by one of us[2], the spin value of ½ occurs more frequently in this type than any other spin value. Further evidence on this point is being published in another note.

We shall shortly publish elsewhere a fuller discussion together with an analysis of the fine structure interval factors in the terms of the 195 isotope.

S. TOLANSKY.
E. LEE.

Physics Department,
University of Manchester.
April 15.

[1] B. Jaeckel and H. Kopfermann, *Z. Phys.*, 99 (1936).
[2] S. Tolansky, NATURE, 135, 620 (1935).

## Reported Occurrence of European Fishes on the Tavoy Coast, Burma

MY attention has been directed to the letter of Mr. J. R. Norman in NATURE of February 22: as the collector of the material in question, I feel it desirable to recapitulate the facts.

At Maungmagan in 1933, I made an extensive collection of fish, some being purchased from the boats before the cargo was landed, some from fishermen standing and casting nets in the waves, the majority collected by myself personally. On arrival at Rangoon, I ordered my laboratory steward to pack and dispatch them to the Indian Museum. Dr. Hora has already stated that his museum possesses no material of European origin; any interpolation of strange fish must therefore have occurred in my department.

To the best of my belief, and after consultation of such records as are available, the department has neither purchased nor had given to it any specimens of European fish: though I am naturally not prepared dogmatically to exclude the possibility of error, it is difficult to see how the European forms could have intruded. I believe I can recollect the collection of a *Cottus* and a *Blennius*, but again memory, after the lapse of a year, is liable to be untrustworthy. If circumstances permit, at the same time at the same place this year I will make a further collection which may finally settle the dispute.

In conclusion, facts—or the sincere belief of the observer, whichever may be preferred—cannot be

dismissed by the statement that they are "so widely opposed to geographical distribution as scarcely to merit serious consideration". The history of zoology is full of inconvenient records and, although I am fully prepared to admit the improbability of the present ones, I also hold that they cannot simply be ignored as contrary to theory.

F. J. MEGGITT.

University College,
Rangoon.

## Darwin's *Cavernularia*

SOME years ago, I discovered in the cellars of the Cambridge Museum of Zoology a specimen of the sea-pen *Cavernularia* with the label "Voyage of the *Beagle*. C. Darwin. Galapagos Is." I described[1] it briefly under the name *Cavernularia darwinii*.

A point of special interest about this specimen is that there was no record, at that time, of any species of *Cavernularia* or of the closely related genus *Veretillum* found on the eastern side of the Pacific Ocean.

Quite recently, Miss Elisabeth Deichmann[2] has described a species under the name *Veretillum binghami* from the Gulf of Lower California, which I feel sure is identical with the *Cavernularia darwinii* of the Galapagos Islands. It may be sufficiently distinct to be called a variety of that species (such as *Cavernularia darwinii* var. *binghami*), but the essential point is that it is now known that these Pennatulids do occur, and apparently in large numbers, on the coast of Lower California.

SYDNEY J. HICKSON.

[1] *Proc. Camb. Phil. Soc.*, 20, 3 (1921).
[2] Bull. Bingham Oceanogr. Coll., Yale, 5, 3 (1936).

## A Colour Reaction for the Detection and Determination of Vitamin D

OUR endeavour to find a chemical method for determining vitamin D in the presence of ergosterol and other sterols led to a colour reaction specific for vitamin D—in so far as this reaction is not given by ergosterol and its irradiation products.

The test is carried out in the following way: the solution of sterols (dissolved in benzene, petroleum ether or chloroform) is evaporated in a test-tube to about one quarter of a cubic centimetre and 5–10 drops of a 0·1 per cent solution of pyrogallol in absolute alcohol are added. After heating on a water bath, 2–4 drops of a freshly prepared 10 per cent solution of dry aluminium chloride (sublimed, "pro synthesi") in absolute alcohol are added and the heating is continued. If vitamin D is present, a deep violet colour appears at the bottom of the test-tube, reaching its maximal intensity about four minutes after heating started. For the subsequent colorimetric determination, the product of the reaction is immediately dissolved in absolute alcohol (lilac-red coloured solution), and a current of dry carbon dioxide is blown over the surface in order to prevent further oxidation; the test-tube is then closed with a rubber stopper.

Under these conditions, cholesterol, ergosterol, lumisterol give no colour reaction; suprasterol II (A. Windaus), however, in the same concentration as vitamin D, gives a fainter tint[1]. Fatty or oily solutions of vitamin D must first be carefully saponified; the solvent is then evaporated *in vacuo* and the reaction can be carried out with the petroleum ether extract. This extract must be absolutely dry (use anhydrous sodium sulphate) and free from any fatty substances. Solvents other than petroleum ether, benzene, chloroform or absolute alcohol must be eliminated by distillation before starting the reaction. Since prolonged heating of a solution of pyrogallol and aluminium chloride in absolute alcohol gives rise to a faint pink colour, the addition of alcohol must be avoided before the reaction has taken place.

The quantitative determination can be easily carried out by means of an ordinary colorimeter[1] or a Zeiss-Pulfrich-Stufenphotometer. The reading can be made within an hour after the test. During this time the colour does not change markedly provided the above-mentioned procedure is followed carefully. So far we have analysed three specimens of pure vitamin D (calciferol) and obtained uniform results. Commercial samples of vitamin D in natural oils, as well as solutions of weighed amounts of calciferol in olive oil, have also been tested: the results were in accordance with the indicated strengths and the theoretical values, respectively. The smallest detectable amount is about 0·002 mgm. of vitamin D. The optimal quantity for the colorimetric determination has been found to be within the limits of 0·01–0·1 mgm. The detection of vitamin D in mixtures containing vitamin A and related products (for example, cod liver oil) can only be carried out after removal of all other substances which give a colour reaction with the above mentioned reagents[2].

We are greatly indebted to Sir Henry Dale for the interest which he has taken in our work and for providing us with a sample of calciferol. We should like also to express our sincere gratitude for the help given us by the Glaxo Laboratories Ltd., which furnished us with samples of calciferol and lumisterol.

WILHELM HALDEN.
HARIKLIA TZONI.

Medizinisch-chemisches Institut,
Universität, Graz.

[1] A communication on the colorimetric method will be published in a separate paper by Mrs. Hariklia Tzoni.
[2] The results of our work on this subject will be published later in a separate paper.

## X-Ray Study of Myosin

IN a recent paper[1] the following passages occur: "Astbury finds that certain changes occur when wool is treated with steam. When myosin is exposed to steam similar changes are detected (*sic*). Astbury and Dickinson suggest that the myosin in muscle undergoes this change in the course of muscular activity": and "The change in myosin known to occur when muscle becomes active is therefore distinctly different from the change that Astbury and Dickinson suppose takes place".

We should like to point out that we have never expressed such an opinion, as readers of NATURE may readily verify for themselves by referring to our communication[2]. At the moment, we are concerned in trying to establish what appears to be a remarkably close analogy between the X-ray and elastic properties of myosin and the supercontracting form of keratin; but as for what chemical changes are involved in muscle itself in bringing about the

postulated elastic changes in the configuration of the myosin chain-molecules, we have never expressed any views on the matter, since our experiments on living muscle are still incomplete.

Such unjustified statements as those here mentioned cannot but be damaging to the much-desired co-operation between physics and biology, and we feel that they should not be allowed to pass unchallenged.

W. T. ASTBURY.
SYLVIA DICKINSON.

Textile Physics Laboratory,
University, Leeds.
May 8.

[1] A. E. Mirsky, *J. Gen. Physiol.*, **19**, 571 (1936).
[2] W. T. Astbury and Sylvia Dickinson, NATURE, **135**, 95 (1935).

## Ascorbic Acid in Paroxysmal Hæmoglobinuria

IN examining C hypovitaminosis we found a patient, suffering from paroxysmal (cold) hæmoglobinuria, highly deficient in ascorbic acid. The patient was treated with ascorbic acid, 300 mgm. being given intravenously for several days. The hæmoglobinuria, easily elicited before, disappeared. Though the treatment was stopped more than six weeks ago, no paroxysm can now be stimulated. The protective action of ascorbic acid on red blood corpuscles could also be demonstrated *in vitro*. We think this experience justifies a trial with ascorbic acid in blackwater fever.

L. ARMENTANO.

Medical Clinic,
Szeged.
March 12.

## Origin of the Word 'Monolayer'

I SHOULD be very much obliged if any reader of NATURE could say who first coined the convenient word 'monolayer' (or 'monofilm'), as an abbreviation of the rather cumbrous expression "monomolecular (or unimolecular) layer".

F. G. DONNAN.

Department of Chemistry,
University College,
London, W.C.1.

# Points from Foregoing Letters

PROF. H. MUNRO FOX shows that the oxygen consumption of English marine invertebrates is greater than that of northern species, each at the temperature of their habitat, and, since their activities are the same, he postulates a greater non-locomotory metabolism. Ciliary activity is parallel to oxygen consumption, but respiratory movements of the warmer-water Crustacea are no faster than those of colder-water species, and thus correspond to the similar oxygen consumptions postulated for locomotion.

Dr. R. Peierls points out that Shankland's experiment is compatible with the assumption that, in the Compton effect, a recoil electron and a secondary photon are emitted simultaneously, although not in the relative directions current theory would require. This assumption would also be compatible with the positive result of the Bothe-Geiger experiment.

Accepting Milne's theory, according to which the multitude of distant galaxies form a continuous luminous background for the night sky, M. Leontovski calculates the spectrum of this background. He concludes that more than half the radiation with which the universe is filled is infra-red, and that to a very sensitive eye the colour of the night sky would appear dark red.

Drs. H. von Halban, jun. and P. Preiswerk confirm Frisch and Placzek's assumption that the ability of boron to capture neutrons decreases with the velocity of the neutron; there is as yet no definite proof that the capture cross-section is proportional to $1/v$. The authors describe results of various experiments on neutrons captured by lithium, dysprosium, silver and rhodium.

Dr. D. Meksyn suggests that a neutron is formed from a proton and an electron with conservation of energy and momentum, the excess energy of the particles being transformed into rest mass. A neutron has no definite mass; the kinetic energy of β-rays at disintegration is acquired at the expense of the rest mass of a neutron.

Further study of the decomposition of acetaldehyde (between 360° and 500°) in 'packed' and unpacked tubes, leads Prof. M. W. Travers and R. V. Seddon to the conclusion that the process is more complex than has been suggested hitherto. They believe that a short-lived intermediate compound is formed, which may either give rise to methane or, if it strikes a surface during a given short period, may lead to the formation of propylene. Hence the latter is preferentially formed in 'packed' tubes.

J. B. M. Coppock and S. M. Partridge find there is no change in optical rotatory power and other physical constants in the reduction products of γ-phenyl-α-methylallylalcohol with light and heavy hydrogen.

The absorption of light by sulphuric acid, potassium, silver and zinc sulphates and by ammonium nitrate, in the vapour state, has been determined by M. Israrul Haq and Prof. R. Samuel. The authors point out the bearing which their results have on the energy of dissociation of $SO_3$ and $SO_4^{--}$ and upon the constitution of ammonium nitrate.

A table giving the displacement in the fine structure of certain lines in the arc spectrum of platinum (connected with the presence of the four isotopes 198, 196, 195 and 194) is given by Dr. S. Tolansky and E. Lee. Their measurements are in good agreement with those of Jaeckel and Kopfermann, and indicate that the isotopic displacements of the three even isotopes are equidistant, the lightest isotope, 194, lying deepest.

A colour reaction specific for vitamin D—in so far as it is not given by ergosterol and its irradiation products—is described by Dr. W. Halden and Mrs. H. Tzoni. It depends on the appearance of a deep violet colour on the addition of pyrogallol and aluminium chloride (in alcoholic solutions) to a suitably prepared sample. Vitamin A and related products must be removed.

ERRATUM. Referring to the note in this column (May 16) on apatite in the enamel of teeth, J. Thewlis points out that apatite is represented by the general formula $3(Ca_3P_2O_8)CaX$, in which X can represent O, $(OH)_2$, $CO_3$, $F_2$ and $Cl_2$; the particular form of apatite present in teeth has not been determined, but it is known that practically *no* fluorine is present.

# Research Items

## Honey-Hunters of Tanganyika

AN isolated group of Wangindo in the north-eastern foothills of the Mahenge massif, Tanganyika Territory, live the life of their forefathers, for geographical reasons little influenced by the outside world. There are only a few hundreds of them, their more numerous kinsmen living a long distance off across the Liwale District border. They have no stock, but disliking the settled life of agriculture, hunt game with poisoned arrows, and above all like to wander off, sometimes for weeks, in search of honey. In an account of these people by the Rev. A. T. Culwick in *Man* of May, it is said that honey is the keystone of their economy. The Mgindo thinks in terms of honey, his house smells of it, his children are smeared with it, and his conversation invariably turns to "that hollow tree two days walk away where the bees are". The honey bird is his greatest friend and he will follow its call for days. When the tree with the honey is found, he cuts it down, taking the honey, but never failing to leave some of the grubs for the bird. The Wangindo make beehives, but do not hang them near their villages. They place them far away in inaccessible parts of the forest, finding them unerringly without blazing. The beehives are cylinders made of strips of bark of the *miombo* tree. One end of the cylinder is closed by a flap of bark bent over and held in place with a piece of string passed through holes. It is placed in a tree with the open end rather lower, to prevent the rain from getting in. Occasionally, but not universally, aromatic herbs are put in to attract the bees. When the honey is ready, the bees are driven out by smoke from a grass torch. The honey is placed in a bowl of hartbeeste skin and lowered to the ground by a rope attached to tongues of skin left for the purpose. The honey is squeezed from the comb by hand and eaten uncleaned. The wax is boiled, filtered, and then remelted into lumps for sale to traders. Though many Wangindo are travelled and even have been in Government service, they always return to their wild life.

## Undescribed Pebble Industry from Natal

A HITHERTO undescribed flaked pebble industry was first observed by Mr. J. F. Schofield and Mr. J. G. Cramb on coastal sites in the neighbourhood of Durban so long ago as 1929, but it was not possible to decide on its exact horizon until a more definite stratigraphy was established. This was afforded by the Tongaat River site, discovered in December 1935, in which the pebbles were not only found in large quantities, but were also closely associated with implements of which the antecedents were more fully known. In a description of the industry by Mr. Schofield (*Ann. Durban Museum*, **3**, 5; 1936), the lydianite pebbles, from which the implements are made, are said all to be small, the largest being less than two inches in diameter, and nearly all were very thin, not more than 5–6 mm. in thickness, differing in this from all pebble industries previously described. The implements were made from both pebble flakes and pebbles. The types of implements are end-scrapers, hollow end-scrapers, bevelled end-scrapers, points, crescents and gravettes. Three degrees of patination have been noted. The implements have been found in association with Bantu pottery, Asturian core implements, implements of Wilton and Smithfield types, Still Bay implements and Glen Grey type implements. Their position in the time-scale is, however, indicated by the stratification at the Tangaat site, on which a layer of sterile sand, six feet thick, separates the industry from the Bantu deposits; and although the pebbles are associated in a few instances with Late Middle Stone Age material, they evidently belong to the Later Stone Age cultures of the Natal coast. They form a link between the Late Stone Age industries which succeeded each other amongst the prehistoric inhabitants, who nevertheless remained ethically constant. This is consistent with the view of L. H. Wells that the Bush–Boskop hybrid race remained constant along the south-eastern seaboard, until it was further hybridised by Bantu–Bush hybrids.

## Biological Control of the Sugar Cane Hopper in Hawaii

ACCOUNTS of the lengthy campaign for the biological control of the sugar cane leaf-hopper (*Perkinsiella saccharicida*) in Hawaii have been published from time to time by the Hawaiian Sugar Planters' Association. The insect was first observed in Hawaii by Dr. R. C. L. Perkins in 1900. How, or exactly when, it reached Hawaii can only be conjectured. It seems, however, very evident that it came with imported cuttings of cane for planting, and it was ultimately determined to be an undescribed species from Queensland. This fact, coupled with the circumstance that it did no noticeable damage in Australia, led to the conclusion that it was probably held in check by natural enemies. A plan was formulated for the control of the leaf-hopper by biological means, since the creature had attained a status of a major pest of cane in Hawaii. The immediate outcome was the organisation, in 1904, of a Division of Entomology at the Experiment Station of the H.S.P.A. The next step was the journey to Australia made by Mr. A. Koebele and Dr. R. C. L. Perkins with the object of studying leaf-hopper parasites. A number of parasites were discovered and ultimately established in Hawaii, but the final subjugation of the pest came later. This was only achieved when the predaceous plant-bug *Cyrtorhinus mundulus*, discovered in 1920 by the late Dr. F. Muir in Queensland, was introduced and established. In 1923 the biological control of the leaf-hopper was considered to be complete, and it has remained in a state of repression ever since. A connected account of the history of the pest, along with its biological control, is given by Mr. O. H. Swezy in Bulletin 21, Entomological Series, of the H.S.P.A. Experiment Station, Honolulu (Jan. 1935).

## Asexual and Sexual Development in Ascidians

IN an interesting paper comparing sexual and asexual development, Dr. N. J. Berrill (*J. Morph.*, **57**, 353) has brought out many sharp contrasts

between the development of eggs and of buds in Ascidians. From a review of the literature concerning mitosis, tissue culture, regeneration and differentiation, it is concluded that cells cannot maintain structural differentiation during mitosis, and such cells are therefore unable to divide, or may divide amitotically, or may dedifferentiate before division. Cells which have dedifferentiated can only redifferentiate along the original line. In bud development, the cell sizes are minimal, polarity and bilaterality are present before development begins, and gross differentiation of form becomes apparent from the beginning. The initial bud masses contain only 40 cells in *Distaplia* but 1,000 or more in *Ecteinascidia*, and these cells undergo eight to ten cleavages. Cytological or cellular differentiation apparently begins only when cell divisions have ended. When there is no nutritive limitation, cell division continues until there are sufficient cells for the expression of all the characters, and the course of development is direct. If there is nutritive limitation, the number of cells is less and some characters may not be expressed until later. The large size of egg cells is due to an inhibition of cell division, a physiological condition which in some respects resembles anæsthesia. In sexual development, cleavage and differentiation are fundamentally dissociable processes, the rate of cleavage finally diminishing as a state of equilibrium is approached, represented by the attainment of minimal cell size for the species.

### Some New British Copepods

IT is not often that copepods new to science are recorded from Britain, but in his recent paper, "Copepods from the Interstitial Fauna of a Sandy Beach" (*J. Mar. Biol. Ass. United Kingdom*, 20, No. 2; 1935), Dr. A. G. Nicholls describes several new species and three new genera from Kames Bay, Millport. The copepods, in contrast to true sand-burrowing animals, do not displace the particles of sand through which they move but crawl over the surface of the grains. Wilson (1932) first directed attention to the abundant copepod fauna of such regions, describing his method of collecting, and introducing a number of new genera and species. The same method is followed by Dr. Nicholls, and the number of new forms described is interesting and surprising. All are feeble swimmers and move with an incessant wriggling worm-like motion; they are all minute, and, although belonging to different families, have many features in common, being elongate and cylindrical, with scarcely any demarcation between metasome and urosome, and in some cases with peculiarly modified spear-shaped setæ on the swimming legs which are found in no other habitat. The different species show an almost specific distribution from low water to the highest part of the beach, which is submerged only by the highest tides and may receive large quantities of fresh-water from rain directly or by drainage. In some cases specific vertical distribution is shown, certain species being restricted to the top two or three centimetres of sand, while others are found only below this, at least during the period of tidal exposure. Those which inhabit the superficial parts of the beach may be subject to considerable changes of salinity. All the species appear to breed continuously, though they are more numerous in spring and summer than later in the year.

### Polarity Phenomena in Cambial Activity

RECENT experiments with the aspen poplar (*Populus tremuloides*, Michx.) by A. B. Brown have produced results which lead the author to suggest that cambial activity is not rigidly polar in its development in the root. In the present contribution (*Canad. J. Res.*, 14, Feb., 1936), he describes experiments which involved ringing the roots which attach sucker shoots to the parent plant, the rings being made so that cambial activity was interrupted in one or more places at once. It was found that a much greater cambial activity in the morphologically upward direction took place than has hitherto been observed. On the other hand, similar experiments in stems produced very little cambial activity in the acropetal direction, and where a vigorous burst of activity was noticed the gradient of tissue production fell very rapidly. In the face of the results obtained from roots, the author suggests that cambial activity may not be inherently polar in its development, but that it shows a tendency to development in a morphologically downward direction rather than in a morphologically upward one.

### White Rot of Lime Trees

THE common timber-rotting fungi do not usually attack lime trees, but the 'pitch-crust' fungus, *Ustulina vulgaris*, has the notoriety of being able to do so. Mr. W. H. Wilkins has made a study of the disease (*Trans. Brit. Mycol. Soc.*, 20, Pt. 2, 133–156, January 1936). The causal organism was isolated, and its pathogenicity established by re-infection. A lengthy report of the distribution of diseased and discoloured wood appears in the paper. Microscopic examination showed that the fungus attacked the cell-walls of the tracheids, but made its way along the woody tissue by way of the pits. The vessels, rays and parenchyma were practically unaffected. A barrier of discoloured wood marked the advance of the fungus up the trunk, and also into the roots. The disease is not widely distributed; but it rapidly destroys the commercial value of an infected tree.

### The Diamond Pipes of South Africa

THE helium-ratios of a series of rocks and minerals from the kimberlite pipes of South Africa have been determined by A. Holmes and F. A. Paneth (*Proc. Roy. Soc.*, A, 154, 385–413; 1936). The helium-ratio of kimberlite, corresponding to an age of fifty-eight million years, is consistent with the late-Cretaceous age assigned to the diamond pipes. It is found that amphibolite xenoliths, known to represent Pre-Cambrian rocks, give 'ages' much higher than that of kimberlite. Three eclogite nodules have similar high helium-ratios and are thus proved to be accidental xenoliths representing pre-existing crustal rocks of much greater age than kimberlite. Holmes points out that this result shows that his hypothesis for the origin of potash-rich ultrabasic rocks has become untenable, since it was based on the assumption that kimberlite was a residual magma generated from peridotite magma by early crystallisation of eclogite and dunite. Xenoliths of the peridotite-pyroxenite suite from kimberlite, including zircons, are all found to have 'low' helium-ratios. Such low results are ambiguous, since they might indicate either (*a*) that the xenoliths were *cognate* with kimberlite, or (*b*) that the xenoliths represent old crustal rocks which lost their helium

at the time of their incorporation in the original magma of kimberlite. The second alternative is favoured by the fact that zircons from kimberlite investigated by Lord Rayleigh in 1909 proved to have a high helium-ratio, pointing to a Pre-Cambrian age for the zircon-pyroxenites to which Williams has traced the zircons. It is concluded that at least some of the members of the peridotite suite represent a deep-seated crustal layer of ultra-basic rocks.

### The Gulf Stream and Agulhas Current

OBSERVATIONS of salinity, temperature and dissolved oxygen of the water, taken by the research vessels *Atlantis* and *Discovery II* on lines of stations across the Gulf Stream between Chesapeake Bay and Bermuda and across the Agulhas Current southward from Port Elizabeth, have recently been compared ("Aufblau und Bewegung von Golfstrom und Agulhasstrom", G. Dietrich, *Naturwiss.*, April 10, 1936). In both instances the least oxygenated layer lies at a depth of roughly 1,000 metres, rising to lesser depths on approaching the American coast. On the assumption that the current has the least and negligible velocity in this layer, the relative velocities in the other layers have been calculated by means of Bjerknes's theory. Force due to the earth's rotation causes a 'piling up' of the water, which can be calculated. The observed differences in mean sea-level along the United States coast are considered.

### A New Densimeter

WHEN the density of a liquid is to be determined by using density bulbs, it seldom happens that any of the bulbs has exactly the right density. In a communication to the Editor, Dr. K. Kuhlmann, of the Institute of Fisheries, Moscow, states that by making a portion of the wall of a bulb flexible and subjecting the liquid under test to a measured pressure, the volume of the bulb can be so adjusted that its density is that of the liquid. From the pressure applied, the density may be calculated if the temperature is also known. The device is an application of the principle of the well-known hydrostatic toy, the 'diver'.

### Magnetic Energy Spectrum of Cosmic Rays

P. M. S. BLACKETT has described (*Proc. Roy. Soc.*, A, May 1) a large electromagnet constructed to deflect cosmic ray tracks in a cloud chamber, and its use to obtain the energy distribution of cosmic rays. Unlike the solenoids used by some other workers, the magnet can be run with a rather low power consumption; 25 kw. allows tracks 17 cm. long to be photographed in a field of 14,000 gauss. The magnet has a 8,000 kgm. iron circuit and 3,000 kgm. copper windings. An innovation is the use of an air blast for cooling instead of water or oil. The technique of obtaining and measuring the cloud-chamber tracks has been elaborately worked out. The distortions introduced by unsymmetrical expansion in the chamber and by the photographic lens were eliminated by comparison with a set of tracks taken with no magnetic field. It was found possible to estimate particle energies up to about $2 \times 10^{10}$ e.v., and an energy spectrum was obtained based on observation of 188 particles. The frequency of the tracks falls off with increasing energy roughly according to $1/E^2$, and positively and negatively charged particles occur in about equal numbers. The paper contains incidentally some interesting observations on the image curvatures introduced by high aperture photographic lenses (see also NATURE, May 16, p. 838).

### Cosmic Ray Showers

E. C. STEVENSON and J. C. Street have recently described experiments on the production of 'showers' by cosmic rays (*Phys. Rev.*, March 15). Photographs were taken with a large metal-lined wooden cloud chamber controlled by a coincidence arrangement of three Geiger-Müller counters. One counter was placed above and two below the chamber, and a lead plate was placed in the middle of the chamber. A number of complicated showers were observed, but the most striking observation was the frequent appearance of a divergent shower below the plate, apparently produced by a single electron incident from above. The counter arrangement is, of course, adapted to select this phenomenon. The most generally accepted view of shower formation has been the conversion of a photon, and a number of the observed showers were apparently produced in this way. The production of showers by single electrons is new and rather unexpected.

### Maximum Vehicle Capacity of a Highway

IT is stated in *Roads and Streets* of April that a very extensive survey of highway accidents in the United States was concluded in 1934 under the supervision of the Massachusetts Institute of Technology, the Federal Government providing £100,000 towards the expenses. More than two and a half million cars were studied when running on the road, and statistics of accidents were obtained from 200 towns and cities. One section of the report deals with the mathematical analysis of accident situations, and is instructive. Various formulæ have been suggested for the safe distance to be maintained between two vehicles following one another at the same speeds. The distance between the centres of the vehicles is equated to the sum of three terms, one a constant, another proportional to the velocity and the last proportional to the square of the velocity. It is necessary to assume that the coefficient of friction is constant at all speeds. Philadelphia and New York adopt formulæ of this type, the deceleration in the former formula being taken as 19 feet per sec. per sec. and in the latter 15 feet per sec. per sec. A reaction time of half a second is allowed in both cases. It would seem that some additional allowance should be made for a possible superiority in the braking power of the leading car. The Massachusetts Registry of Motor Vehicles tested on the road 687 pleasure vehicles with four-wheel brakes. Seventy-six per cent of these could be stopped from 20 m.p.h. in the standard distance of 30 feet or less. But only about 4 per cent could be stopped in less than 20 feet. An interesting corollary to the mathematical analysis of highway capacity is the case where a two-lane road is reduced at some point to one lane. Taking the curve giving the maximum capacity of a two-lane road in cars per hour, it is shown that the maximum number of cars per hour is 1,800. Each lane of the two-lane section must therefore discharge cars at a rate not exceeding 900 cars per hour. But this is accomplished at a speed of about 5 m.p.h. Hence no matter how full the single lane may be in time of congestion, traffic cannot pass along the two-lane road faster than 5 m.p.h. This explains the extremely slow speeds often experienced in congested highways.

# Use of Electricity in Agriculture

CONFERENCES on the immediate problems of crop production are held periodically at the Rothamsted Experimental Station. The twenty-first report* is on the use of electricity in agriculture. The completion of the Grid system and its subsidiary lines in Great Britain is bringing many rural areas within reach of a supply of electricity. While generally admitting its convenience, farmers require more information about costs as compared with internal combustion engines.

There is also some confusion in the minds of consumers as to the reasons which lead the companies to ask for guarantees, minimum charges, two part tariffs, etc. Mr. M. M. Harvey, in a paper on the best way to use electric power, gives explanations which appeal to the agriculturist. Discussing the extra cost of rural distribution over town distribution, he explains that if a farmer retails a 100 gallons of milk daily from vans in a few streets, two or three vans can deal with this retailing, and the delivery costs per gallon are low. It is obvious that if he has to retail to the same number of consumers the same number of gallons over the whole of his county, the distribution costs per gallon would be many times his town delivery costs, and he would have to obtain a higher price per gallon to cover this. Similarly, farmers ask why they are having to pay at a higher rate for having a large transformer than for having a small one; apparently they are being penalised for occasionally making a larger demand on the supply system. The explanation given is that if a purchaser take 50 gallons of milk daily as a maximum, then they could budget for sufficient cows to give this supply. But supposing the purchaser said he required 200 gallons on one day of the year, then the farmer would have to keep a larger herd simply to supply this one day's demand. He would therefore be justified in charging extra for the availability of a larger supply of milk occasionally.

Everyone admits the great convenience of electricity for light and power. It saves a great deal of labour when a piece of work can be started and finished simply by pressing a button. Modern electric motors are so good, and their moving parts so well enclosed, that a breakdown is a very rare occurrence. The supply companies are willing to test them periodically. A farmer who contemplates installing electricity will find in Mr. Harvey's paper data about farms of all kinds, some of which will doubtless be like his own.

In a foreword by Sir John Russell, it is pointed out that the experiments made at Rothamsted show that for the same grinding rate and fineness of grinding, 4·6 units of electricity per hour were equivalent to 2·3 pints of Diesel oil per hour. At the price paid (1·42*d.* per unit), electric power came out a little more expensive than paraffin, when overhead costs were neglected. When such costs were taken into account, however, electric power was cheaper than paraffin, although a little more expensive than Diesel oil. Electric power in its ease of application and cleanliness possesses many advantages. No attempt to estimate the value of these advantages has been made.

In the present report nothing is said about electrical ploughing or electrical discharges over crops. The latter is now believed to have little, if any, value. The Conference discussed only the practical applications of electricity. In future conferences, horticultural possibilities such as obtaining early crops by heating the soil will doubtless be discussed.

* Rothamsted Conferences, 21: The Use of Electricity in Agriculture; being a Report of a Conference held at Rothamsted on January 29th, 1936, under the Chairmanship of Sir Bernard E. Greenwell. Contributions by Sir E. J. Russell, M. M. Harvey, B. A. Keen and G. H. Cashen, F. E. Rowland, C. A. Cameron Brown and others. Pp. 77. (Harpenden: Rothamsted Experimental Station, 1936.) 2*s.*

# Organisation of Plant Cytoplasm

A VERY valuable summary of modern views on this difficult subject will be found in two little monographs* by Prof. A. Guilliermond of the Sorbonne, dealing respectively with the 'chondriome' and 'vacuome'. These two names are given by the author to two distinct types of morphological unit which can be found in varying form in the cytoplasm throughout the life of the cell. The cytoplasm itself is regarded as an optically empty colloidal solution of long colloidal thread molecules (proteins, etc.), which have imbibed so much water that their refractive index approximates to their aqueous medium. They thus give the properties of a viscous sol to the cytoplasm, but the thread molecules link up at any surface to form an elastic solid plasma membrane.

The vacuome and chondriome systems can be distinguished by their behaviour to vital stains. The vacuome system stains heavily when the living cell is in dilute solutions of neutral red. In the meristem cell the vacuome system thus revealed is a concentrated colloidal solution dispersed in small drops or threads amongst the cytoplasm, but cell expansion is largely determined by the entry of water into this system, which then coalesces in stages into the well-known 'vacuole', in which the colloidal substances are dispersed in dilute solution and precipitate as red-staining granules in the presence of neutral red.

The chondriome system does not stain *in vitam*, but subvitally will take up Janus green; thus

*Exposés de biologie (embryologie et histogenèse). Par Prof. A. Guilliermond. 2: Les constituants morphologiques du cytoplasme; le chondriome. Pp. 126. 20 francs. 3: Les constituants morphologiques du cytoplasme; le système vacuolaire ou vacuome. Pp. 108. 18 francs. (Actualités scientifiques et industrielles, 170, 171.) (Paris: Hermann et Cie, 1934.)

simultaneous demonstrations of the two systems is temporarily possible with neutral red and Janus green.

The lipin nature of the chondriome makes it disappear in acetic acid or alcohol fixatives unless unsaturated fatty acids are first oxidised to hydroxy acids, less soluble in alcohol and xylol, as by treatment with chromic acid or osmic acid, etc. The vexed questions of the relation of the chondriome system to the plastids; of the methods of multiplication in embryonic cells of both vacuome and chondriome, and of the relation of the vacuome system to the Golgi network or the Holmgren canals are discussed very concisely and with a full citation of the work upon animal cytology which will be very valuable to the botanist.

# Zooplankton of the Great Barrier Reef*

FOLLOWING the general report on the zooplankton of the Great Barrier Reef (noticed in NATURE of August 3, 1935) more detailed work on the different groups is now in progress. The pelagic animals belonging to the Tunicata, Mollusca and Siphonophora are here discussed. Comparison with other expeditions is emphasised, particularly the *Siboga* Expedition, but in this year's work on the Barrier Reef a continuous series of samples is available, giving valuable information as to seasonal distribution and life-histories which has never before been obtained to such an extent. Identification of species has already been made by Miss A. B. Hastings (Tunicata), Mr. A. K. Totton (Siphonophora) and Miss Anne L. Massy (Pteropoda), whilst Prof. Paul Pelseneer has looked through the larval gastropods. Identification was not possible in the last group and in the larval lamellibranchs, but reports on the Tunicata and Siphonophora have already been published (in Vol. 4 of these reports).

The larger tunicates were abundant in the stramin net, but among the great numbers of small animals retained by the silk net they were less important. On the average, the tunicates formed one half of the total number of animals caught in the stramin net, while in the coarse and fine nets, oblique hauls, these proportions were only 5·7 per cent and 2·7 per cent respectively. The total collections comprised three species of Doliolids, six species of Salps and eight species of Appendicularians; but the only species which played an important part in the composition of the plankton at the weekly stations were *Salpa democratica*, *Oikopleura rufescens* and *O. longicauda*. On the average for the year, the Thaliacea far outnumbered the Appendicularians in the stramin catches; but there were violent fluctuations in the composition of the Tunicata due to swarming of certain species, especially *Salpa democratica* and *Megalocercus huxleyi*. In the coarse silk net small appendicularians preponderated, except in months when swarms of salps were met with. In both nets the Doliolids were on the whole of small significance.

Easily the most abundant salp was *Salpa democratica*, with two maxima—September–January, and April–May; during the remaining months it was almost completely absent. On only a few days really large catches were made when the salps were often to be seen in the sea in enormous numbers. The spring increases occurred at full moon, the later increases at or after new moon. The authors are of opinion, however, that the salp increases do not really indicate a lunar periodicity in breeding, but that they indicate successive outbursts of reproduction in the waters round Low Island, the sudden peaks being due to swarms drifting up the Barrier Reef Lagoon. The chief increases occur when the temperature is between 24° and 28° C. It is probable that salinity has no effect on their presence, whilst temperature is important. The comparatively few salps in the collection may indicate that those caught are the better able to live in shallow coastal water, and the same may hold good for appendicularians, or it may be that in some years other species will be found which, owing to sparse distribution, were not brought near the coast in this one year.

Of the Appendicularians treated as a whole, *Oikopleura rufescens* and *O. longicauda* are the most abundant, the maximum occurring in January and February, coinciding with the highest temperature and decreasing salinity. The Barrier Reef collections are so far the only records giving a full picture of a year's course in a region in the Pacific where warm tropical water conditions exist throughout the year. The absence of *Oikopleura dioica* is striking. Of the Mollusca, the pteropods are much the most important, although there were numbers of larval gastropods and lamellibranchs at times. Here again the pteropod records contain the first contribution towards their seasonal study in the tropics. Only three are important in the coastal waters of the Barrier Reef, *Creseis acicula*, *C. virgula* and *Cavolinia longirostris*, agreeing with the results of the *Siboga* Expedition. The creseids extend normally nearer the coast than the other genera.

Siphonophores were much more abundant than medusæ and only a few coral planulæ were caught. Of the thirty-two species of Siphonophores, twenty from the Barrier Reef Lagoon, two species predominated, *Lensia subtiloides* and *Diphyes chamissonis*, and these were responsible for the main fluctuations in abundance during the year. Many species were absent because of low salinity during the heavy rains, but they were probably present outside the reef. That the three species *Diphyes chamissonis*, *Lensia subtiloides* and *Enneagonum hyalinus* were present in the lagoon during the period of low salinity points to the possibility that these species are specially adapted to life in shallow coastal waters. This seems to be the first time that any siphonophores have been definitely recognised as coastal species in a predominantly oceanic group.

* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports. Vol. 2, No. 7: The Zooplankton. 4: The Occurrence and Seasonal Distribution of the Tunicata, Mollusca and Coelenterata (Siphonophora). By F. S. Russell and J. S. Colman. Pp. 203–276. (London: British Museum (Natural History), 1935.) 5s.

# Metallurgical Research at the National Physical Laboratory

VOL. 25 of the "Collected Researches of the National Physical Laboratory" (London: H.M. Stationery Office, 1935. 25s. net) contains some of the more important of the publications which have emanated from the Metallurgical Department during the last ten or twelve years. This volume of 432 pages shows how profound has been the influence that this Department has exercised, particularly perhaps in setting a standard for other workers to emulate. It is not too much to say that every one of the twenty-three papers now collected together is of real importance.

The work is concerned in the first place with the alloys of iron, not the least important of the contributions being those devoted to the preparation of the pure elements chromium, manganese and silicon. The essential part played by refractory materials in such research needs no stressing, and the paper on special refractories for this purpose contains information which will be of the greatest value to all workers in the higher temperature range.

Passing on to the consideration of the work on non-ferrous materials, three papers dealing with the silver – tin alloys and amalgams, which represent work carried out for the Dental Investigation Committee of the Department of Scientific and Industrial Research, lay down for the first time scientific foundations for the study of dental amalgam fillings. Although this work is at the present time in a relatively elementary stage, and far more intense research is required before many of the intriguing problems connected with these materials are solved, a most important commencement has been made.

Other papers are concerned with the transformations in the copper – gold alloys, the constitution and the physical properties of the alloys of cadmium and zinc, the properties of metallic cadmium, the crystal structures of α- and β-manganese, a new form of dilatometer and the surface tension of liquid metals. Particular attention may perhaps be directed to the last of these, since in addition to the measurement of the surface tension for a number of liquid metals and lead – tin alloys, the work has resulted in evidence to show that bismuth, cadmium and antimony may be highly associated in the liquid state. Anything which increases our knowledge, at the present time almost infinitesimal, of the condition of metals and alloys when molten, is most heartily to be welcomed.

Practically the whole of this work was carried out under the supervision of the late Dr. W. Rosenhain, and published whilst he was superintendent of the Department concerned, or soon after his retirement. Although his name occurs once only in this list of papers, and that in the introduction to the researches on the alloys of iron, the volume represents a lasting memorial to the influence which he exercised on research in his own Department, and through it, in most parts of the world. F. C. T.

# Lunar Effects on Atmospheric Pressure

UNDER the heading "Effect of the Moon on Barometric Pressure" a summary appeared in NATURE of November 16, 1935, p. 800 of a paper by R. A. Robb and T. R. Tannahill[1] entitled "The Lunar Atmospheric Pressure Inequalities at Glasgow". A remarkable feature of their results, to which attention was directed, was the relatively large magnitude of the diurnal amplitude compared with that of the semi-diurnal amplitude, the two being in the ratio of more than four to one.

It now appears from a paper by Prof. S. Chapman[2] that this result was due to the presence of a systematic source of error, arising from the plan that had been followed of rejecting all days from the analysis on which the difference of pressure between successive upper transits of the moon exceeded 0·1 inches of mercury. This plan resulted in the appearance of an effect known as the 'convex effect' to which Bartels directed attention in 1927. Such days of small pressure change occur more frequently when the barometer is above than below its normal level, and at such times the pressure curve is near a maximum value and tends to be convex; it follows that in the long run a spurious maximum will be found near the middle of the lunar day, which in this case was reckoned to begin at the lunar upper transit, and that the spurious term will therefore have a phase angle somewhere near 270°.

Chapman points out that the first three harmonic components found by Robb and Tannahill, for which the amplitudes were 64, 15·6 and 8·9 microbars, had phase angles of 267°, 285° and 292° respectively, which illustrate the 'convex effect', and that the results obtained were substantially not of lunar origin. He states, however, that an earlier and hitherto unpublished analysis of the Glasgow data by Robb in 1926, made in such a way that the 'convex effect' was not present, showed correctly that the lunar atmospheric tide at Glasgow is, for the latitude, very small—of amplitude 4 or 5 microbars, that is, about a third of the amplitude at Greenwich and Aberdeen, as had been found by Chapman in the cases of Victoria and Vancouver.

Prof. Chapman has also recently discussed the lunar atmospheric tide in the Azores[3], using unpublished data for Ponta Delgada (38° N., 26° W.) and Santa Cruz (39° N., 31° W.). Bi-hourly barometric data were employed, obtained in each case by interpolation from pressure read at 6, 10, 11, 16 and 21 hours from a Tonnelot compensated barometer with the aid of the continuous record of a Richard barograph, the analysis being made with the aid of Hollerith sorting and tabulating machines lent by the British Tabulating Machine Co. Ltd.

The results are shown by the values obtained for

the semi-amplitude $C_2$ and the phase angle $\theta_2$ of the lunar semi-diurnal variation of the barometric pressure expressed by the formula $C_2 \sin(2t + \theta_2)$, $t$ being lunar time reckoned from the local hour of lunar transit, 360° being a lunar day, while $C_2$ is in microbars. The observational material was divided into seasons (May–August, March April September and October, and November–February), and into groups of a decade or rather less. The mean results were 22 sin $(2t+55°)$ for Ponta Delgada (39 years' observations) and 18 sin $(2t+58°)$ for Santa Cruz (twenty-six years' observations). These phase angles of 55° and 58° correspond to an unusually long lag of high tide (high barometric pressure) after lunar transit), amounting to 72 minutes of solar time at Ponta Delgada and 65 minutes at Santa Cruz. Other places with similar phase angle are Madras (56°), Samoa (59°) and Hongkong (60°). As at most stations, the tide is later near the December solstice than at other seasons; it is common to find also the minimum amplitude at that time, but this was not found at the Azores in as many as half the groups, though the length of time covered by the observations is too small and the probable errors of $C_2$ consequently too large, to make it certain that this tendency is not present. At both stations $C_2$ was substantially smaller in the period 1924–32 than during the earlier periods.

[1] *Proc. Roy. Soc. Edin.*, 4, Part 1, No. 9.
[2] *Proc. Roy. Soc. Edin.*, 56, Part 1, No. 1.
[3] *Quart. J. Met. Soc.*, 62, No. 263, 41 (January 1936).

## Educational Topics and Events

CAMBRIDGE.—F. W. Shotton, of Sidney Sussex College, has been appointed University lecturer in the Department of Geology, and Dr. N. Feather, of Trinity College, University lecturer in the Department of Physics.

The Frank Smart studentship in botany is vacant. Applications should be made to Prof. A. C. Seward at the Botany School on or before June 4.

Candidates for the Michael Foster studentship in physiology are requested to send their applications with a statement of the course of research they propose to undertake to Sir Joseph Barcroft, Physiological Laboratory, by July 7.

At Jesus College, A. E. Green, Smith's prizeman in 1936, has been elected to a research fellowship.

GLASGOW.—The construction of a new Chemistry Institute, the erection and equipment of which will cost approximately £200,000, is to begin almost immediately. Towards the cost of this Institute, the Carnegie Trust for the Universities of Scotland has contributed £118,000, and it is hoped that further assistance will be forthcoming from private sources, as the cost of erecting these new buildings will impose a serious burden on the University. Prof. T. Harold Hughes has been appointed architect of the new Institute.

Prof. R. Stockman is retiring from the chair of materia medica at the end of the current session.

LIVERPOOL.—Mr. Reginald George Batson has been appointed to the chair of civil engineering. Mr. Batson was from 1908 until 1933 principal assistant in the Engineering Department of the National Physical Laboratory, and from then to the present time principal scientific officer in charge of the Road Research Laboratory of the Department of Scientific and Industrial Research, and secretary to the Road Research Board.

LONDON.—The following appointments have recently been made: Dr. Arthur Wormall, senior lecturer in biochemistry, University of Leeds, to the University chair of biochemistry tenable at St. Bartholomew's Hospital Medical College; Dr. W. F. Harper, lecturer in anatomy, University of Aberdeen, to the University readership in anatomy tenable at London Hospital Medical College.

The degree of D.Sc. has been conferred on: M. Mitra (Royal College of Science); E. J. B. Willey (University College); W. G. Penney (Royal College of Science); I. E. White (external student); D. F. Martyn (external student); and the degree of D.Sc. (Engineering) on Prof. Leonard Bairstow, University professor at the Imperial College (Royal College of Science).

The Dunn exhibitions in anatomy and physiology for 1936 have been awarded to R. S. Murley (of St. Bartholomew's Hospital Medical College) and Ernest Petrie (of University College) respectively.

Mr. H. J. Collins has been appointed as from October 1 to the Chadwick chair of engineering tenable at University College. Since 1929 he has been assistant professor in civil and municipal engineering at the College.

H.M. Queen Mary has been pleased to become patron of Queen Mary College, University of London, of which his late Majesty was patron.

DR. ALEXANDER M. SMITH has been appointed lecturer in agricultural chemistry in the Edinburgh and East of Scotland College of Agriculture in succession to Dr. A. Lauder, who retires in September.

DR. L. C. MARTIN, assistant-professor of technical optics in the Imperial College of Science and Technology, has been invited to spend a year in the Institute of Applied Optics, University of Rochester, U.S.A., exchanging with associate-professor Rudolph Kingslake, of Rochester, for the session 1936–37, to whom a reciprocal invitation has been extended by the Imperial College.

PROF. J. G. FITZGERALD, dean of the Faculty of Medicine and director of the School of Hygiene and of the Connaught Laboratories, University of Toronto, has been invited by the Rockefeller Foundation to make a study of the methods at present employed in the teaching of preventive medicine to undergraduates in medical schools. It is anticipated that the study will occupy a period of one year commencing September 15. Dr. Charles Edward Smith of the Stanford University Medical School, San Francisco, will assist in the undertaking. University medical schools in the United States and Canada, the British Isles and in European countries will be visited in the course of the survey. Prof. FitzGerald is to resign as dean of the Faculty of Medicine, University of Toronto, on June 30. He will be given leave of absence by the governors of the University for the necessary period and will, it is expected, return to the University of Toronto in September 1937 as director of the School of Hygiene and of the Connaught Laboratories.

## Science News a Century Ago

### A Surrey Museum

ON May 30, 1836, *The Times* said: "A very interesting museum on a small scale has just been opened in the neighbourhood of the Surrey Zoological Gardens. The principal object of this establishment is professed to be the exhibition of a genuine, rare and nearly complete collection of the birds of the British Isles, and the profession is not belied by what is actually to be seen in the collection. It contains nearly 300 specimens of the feathered tribe of Great Britain, from the gigantic eagle to the diminutive wren. These specimens are many of them remarkably brilliant in plumage, and of beautiful diversities of colours. . . . They are arranged and classified according to the ornithological systems of Selby, Montague and Bewick, and the Linnaean names, as well as those by which they are generally and provincially known to the natives of England, are attached to the cases in which they are contained. There are also some North American specimens, which though in some degree different to the feathered species of our woods and fields, are in many respects extremely similar."

### Sir Francis Pettit Smith's Screw Propeller Patent

OF the many promoters of screw propulsion, the most important was Francis Pettit Smith, the Hendon farmer, whose first patent was taken out on May 31, 1836. Born on February 9, 1808, at 31 High Street, Hythe, Smith was educated at Ashford, and began life as a grazing farmer on Romney Marsh, whence he removed to Middlesex. He was always fond of making models, and early in 1836 he drove a model boat by means of a screw on his pond at Hendon, and at about the same time he exhibited a screw-driven model boat at the Adelaide Gallery. With the assistance of Wright, a banker, and Thomas Pilgrim, a practical engineer, in the summer of 1836 he constructed a boat of ten tons having an engine of six horse-power and a single-threaded wooden screw with two complete turns. From these experiments sprang the developments which led to the building of the *Archimedes*, the *Novelty* and H.M.S. *Rattler*, and the introduction of the screw into both warships and merchant ships. Twenty-two years after he took out his patent, Smith was presented with a testimonial at a public dinner in St. James's Hall, Robert Stephenson being in the chair. The testimonial took the form of a fine silver salver and silver claret jug which Smith bequeathed to the Science Museum. He died in South Kensington on February 12, 1874, and was buried in Brompton Cemetery.

### Temperature of Underground Springs

WRITING to Prof. Jameson on June 1, 1836, J. D. Forbes said: "On occasion of a late visit to the district of Lead Hills I suggested to my friend and former pupil, Mr. Irving of Newton, the importance of determining the temperature of the springs in the bottom of the Lead Hill Mines at this particular epoch. The working having been discontinued since the end of March, any supposed influence of animal heat and light is avoided, and yet the pumping of the water has been regularly carried on. Mr. Irving immediately and zealously undertook the inquiry; and descended to the deepest part of the mine on the 16th of May and found the temperature of the water in the bottom to be 49°. This was at depth of 95 fathoms below the entrance to the Susanna Vein. . . ."

### Visitation of the Royal Observatory, Greenwich

IN his autobiographical notes for 1836, Airy records: "On June 4th the Annual Visitation of the Observatory was held, Mr. F. Baily in the chair. I presented a written Report on the Observatory (a custom which I had introduced at Cambridge) in which I did not suppress the expression of my feelings about chronometer business. The Hydrographer, Captain Beaufort, who was one of the Official Visitors, was irritated: and by his influence the Report was not printed. I kept it and succeeding Reports safe for three years, and then the Board of Visitors agreed to print them; and four Reports were printed together, and bound up with the Greenwich Observations of 1838."

## Societies and Academies

### LONDON

Royal Society, May 21. SIR PATRICK LAIDLAW and W. J. ELFORD: A new group of filterable organisms. A group of filterable saprophytic organisms has been discovered in sewage. In the normal course of their development, they have small forms of about the size of vaccinia virus ($0\cdot125$–$0\cdot175\,\mu$), though larger forms also occur ($0\cdot5\,\mu$ or more). Cultures are readily obtained by filtering mixtures of sewage and Fildes's broth through membrane filters of appropriate porosity, and incubating the filtrates at 30° C. They can be maintained in subculture in indefinite series. Three strains have been isolated which differ in their cultural characters and also serologically, though morphologically they appear the same, and they all show the same end-point in filterability. These organisms are of interest in view of the small forms, which although comparable in size with some of the viruses, can nevertheless lead an independent existence. It is, as yet, uncertain how the organisms should be classified. MARION A. WATSON (HAMILTON): *Factors affecting the amount of infection obtained by aphis transmission of the virus Hy. III.* Experiments have been carried out in order to show the effect of various factors on the percentage of infection obtained with the virus Hy. III in tobacco, using its insect vector *Myzus persicæ*. A maximum percentage infection was obtained during the winter months and a minimum during the summer months. The percentage infection increases with the number of aphids used per plant, and the relation between the numbers of infection obtained for each aphid number shows that the infections are local and independent. The percentage infection increases with increased feeding time on the healthy plant, but there is no indication of a preliminary time period in which no infection is obtained. The percentage infection decreases very rapidly with increasing time on the infected plant from 2 minutes to 1 hour. After 1 hour it increases slightly with further increase of the feeding periods. R. RUGGLES GATES: Genetical and taxonomic investigations in the genus *Oenothera*. This paper presents the results of a three years' genetical survey of the genus *Oenothera* in eastern Canada and adjacent areas. By combining genetical with taxonomic methods, a fuller knowledge is attained of the wild

populations in a particular area than has been possible in any case hitherto. Thirty-two new species and varieties are described, as well as many smaller variations, and much light is thrown on the geographical distribution of these and other forms, as well as their relationships. There are indications of movements from south to north in several different lines of descent, and also of a coastal series of forms with strongly bent stems. Six of these new species have produced trisomic mutations, most of them directly from wild seeds, and one a triploid mutation, which shows that the mutation phenomena are not the result of cultivation. The catenation in all the species examined is a ring of 14 chromosomes. Certain prairie species show marked alteration of habit when grown in England, and a new category of *evanescent characters* is made for differential characters which appear only at certain stages of development.

### PARIS

Academy of Sciences, April 20 (*C.R.*, 202, 1353–1388). ERNEST ESCLANGON: The equations of dynamics deduced from the principle of limited relativity. SERGE BERNSTEIN: The domain of convergence of the polynomials $B_n f(x) = \Sigma_0^m f(m/n) C_n^m x^m (1-x)^{n-m}$. MARCEL GODCHOT and PIERRE VIÈLES: Active methyldiglycollic acid and its derivatives. I. VINOGRADOV: Some new inequalities in the theory of numbers. ROBERT FORTET: Probabilities in chain. PAUL REGNAULD: The encounter of two material bodies. ALEXANDRA PROCA: The theory of the positron. ANDRÉ THURET: The calculation of the specific heats of the mineral oxides vitreous silica, lime, alumina as a function of the temperature. Formulæ expressing the specific heats as a function of the temperature are given for these three substances, and the corresponding curves shown with the experimental values observed by various authors. STÉFAN PROCOPIU: The electromotive force of movement of metals in water and their electro-kinetic potential. ROBERT GUILLIEN: The intensity and form of the absorption bands of liquid oxygen. CHARLES MAUGUIN: The theory of the reflection of the X-rays by crystals. DANIEL SCHNÉEGANS: The stratigraphy of the Lias of the Ubaye sheet in the Morgon massif (Basse-Alpes). JACQUES BONDON and BRANKO YOVANOVITCH: The ante-Carboniferous strata of western Morocco. MLLE. BERTHE DELAPORTE: New researches on the cytology of bacteria. MAURICE DOLADILHE: Contribution to the study of one of the constituents of the acidoglobulins: protein C.

### CAPE TOWN

Royal Society of South Africa, March 18. A. W. ROGERS: The superficial deposits of the Kalahari. (presidential address). H. E. MORRISON and J. T. MORRISON: The relationship between winter rainfall and barometric pressure, barometric tendency and wind direction at Cape Town. A. F. SPILHAUS: A study of the aspiration psychrometer. T. F. DREYER: (1) The archæology of the Florisbad deposits. Evidence indicates that the local development of the fluted flake is older than the coastal development, and that it was here synchronous with the development of the Stellenbosch elsewhere. The evidence is based upon the absence of bone tools, the presence of numerous extinct mammalian fossils, and the distribution of implement types. (2) The archæological succession of the natural deposits at Plettenberg Bay and Mossel Bay. It is deduced that there are a black surface layer, a layer of red sand, and an intercalated reddish yellow layer. This latter contains implements of late Stellenbosch type. At Plettenberg Bay this series overlies a white sand (karringmelk grond) which yields Stellenbosch types. It is presumed that the pre-Red Sand deposits are synchronous at the two places. If this is so, the implements of the lime talus at Mossel Bay would be older than those in the white sands at Plettenberg Bay, which is further indicated by typology. M. H. GIFFEN: The chromosome numbers in the genus *Berberis*. A. C. LEEMANN: Contribution to the study of *Dichapetalum cymosum* and the ecology of the Transvaal veld. P. W. LAIDLER: South African native ceramics.

### MOSCOW

Academy of Sciences, *C.R.*, 4, No. 8–9, 1935. J. NATANSON: The representation of functions by formulæ analogous to the Fourier formula. B. VULICH: Metric spaces of a certain type. N. GUNTHER: Spectral function of certain integral equations. G. GAMBURCEV: Establishment of electro-mechanical equivalents. D. D. SARATOVKIN: Distribution of admixtures at crystallisation. P. N. ULJANOV: Drying and sterilising wood and other structural materials with infra-red rays. R. R. CHUGAIEV: Stability of earth slopes subjected to the action of ground water flow. J. A. ARBUZOV and B. M. MICHAILOV: Thermal disintegration of dimethylcyclohexane. B. A. RUBIN and L. I. NAUMOVA: Problem of biochemical characteristics of varieties in vegetables. V. S. BUTKEVICH and L. K. OSNICKAJA: Consumption of succinic acid by fungus films as affected by acetate. A. P. VINOGRADOV and G. G. BERGMAN: Vanadium in the petroleums and bitumens of the U.S.S.R. A. H. ANDRES and J. VOGEL: Karyological investigation of the embryonal oogenesis in man. G. E. BYKOV: On the age and the conditions of formation of brown coals in the upper Zeya plain. J. V. RAKITIN: Hastening the ripening of melons. S. N. JAGUZINSKIJ: Observations on the variability of *Scenedesmus* Meyen in pure cultures. A. M. POPOV: Fauna of the Avacha Bay and its distribution into communities. A. I. KURENCOV: Zoogeographical conclusions from an expedition to the middle Sikhote-Alin range.

### ROME

Royal National Academy of the Lincei (*Atti*, 22, 551–608; 1935). F. SACCO: Transversal tectonic lines of the Appenine (2). A. PELLOUX: Scheelite from the Gerrei mines in Sardinia. G. LAMPARIELLO: Behaviour at infinity of the usual functions of a point. F. TRICOMI: (1) Transformation and reciprocity theorem of Hankel. (2) A theorem of Abel for Hankel's transformation and some new applications of a formula on Bessel functions. L. SONA: Translo-circulatory current which invests a bilateral lamina (6). G. SUPINO: Plane elastic problem and its interpretation in space (2). S. FRANCHETTI: Liquid state and interatomic forces (2). M. AIROLDI: Case of accelerated erosion in the Valle d'Urba. G. BRUNELLI and G. CANNICCI: Preliminary notice of the chemical and biological characteristics of the Lake of Massaciuccoli. S. RANZI: Researches on the absorption of mineral substances by the embryo of *Sepia officinalis*.

## Forthcoming Events

### Tuesday, June 2

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. G. C. Turner: "Some Problems of Clinical Research in Surgery".

RESEARCH CO-ORDINATION COMMITTEE (in co-ordination with the Engineers' Study Group), at 7.30.—(at the Guildhouse, Eccleston Square, Victoria, S.W.1).—Dr. Enid Charles: "Population Trends in Relation to the Housing Problem".

TEXTILE INSTITUTE, JUNE 3–6.—Annual Conference and Exhibition to be held at the Hotel Victoria, Northumberland Avenue, London, S.W.1.

## Official Publications Received

### Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 8 (Timber Mechanics Series, No. 2): Strength Tests of Structural Timbers. Part 2: General Procedure of Selecting and Testing Joists, with Data on British Columbian Douglas Fir, *Pseudotsuga Douglasii* Carr. By C. J. Chaplin and E. H. Nevard. Pp. 10. (London: H.M. Stationery Office.) 6*d*. net. [224

Acoustics of Telephony. By Dr. E. G. Richardson. (Post Office Green Papers, No. 25.) Pp. 18+4 plates. (London: General Post Office.) Free. [234

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Committee for the Year ended 31 December 1935. Pp. 28+4 plates. (Bristol: Bristol Museum and Art Gallery.) [294

Report by the Hydrographer of the Navy on the Services carried out by H.M. Naval Surveying Service and on the Work of the Hydrographic Department for the Year 1935. Pp. viii. (London: Admiralty.) [304

Saorstát Éireann: Roinn Talmhaiochta (Department of Agriculture): Brainse Iascaigh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1934. Pp. 34. (Dublin: Government Publications Sale Office.) 9*d*. [15

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academical Year 1934–1935. Pp. 106. (Cambridge: Printed at the University Press.) [15

The National Physical Laboratory. Report for the Year 1935. Pp. iv+249+12 plates. (London: H.M. Stationery Office.) 12*s*. net. [45

Ollsgoil na h-Eireann (The National University of Ireland). Calendar for the Year 1935. Pp. viii+306+536+333. (Dublin: National University of Ireland.) [45

Ministry of Agriculture and Fisheries. Bulletin No. 99: Report on Insect Pests of Crops in England and Wales, 1932–1934. Pp. vi+50. (London: H.M. Stationery Office.) 1*s*. net. [75

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 8 (Dissertations accepted during 1935). Pp. iv+181. (Oxford: Clarendon Press; London: Oxford University Press.) 3*s*. net. [75

Patents, Designs and Trade Marks: Fifty-third Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1935. Pp. 22. (London: H.M. Stationery Office.) 4*d*. net. [85

Policing the Saar. (Series A, No. 8.) Pp. 32. (London: The New Commonwealth.) 3*d*. [85

### Other Countries

Meddelande från Lunds Astronomiska Observatorium. Ser. 1, Nr. 140: Critical Remarks on G. Strömberg's Paper "The Formation of Galaxies, Stars and Planets". By Torsten Gustafson and Helge Nordström. Pp. 6. Ser. 1, Nr. 142: On the Correlation between Absolute and Apparent Magnitudes. By W. Gyllenberg. Pp. 9. Ser. 1, Nr. 143: A Method of Analyzing the Distribution of the Stars' Absolute Magnitudes. By W. Gyllenberg. Pp. 10. Ser. 1, Nr. 144: Notes on a Method to determine the Cosmic Absorption. By W. Gyllenberg. Pp. 9. Ser. 2, Nr. 79: A Study of Stellar Motions based on Radial Velocities. By Helge Nordström. Pp. 196. Ser. 2, Nr. 180 (Historical Notes and Papers, Nr. 5): On the Orientation of the Egyptian Pyramids. By Björn Svenonius. Pp. 9. (Lund: Astronomiska Observatorium.) [45

Inigo Jones Seasonal Weather Forecasting Trust: Crohamhurst Observatory. Observatory Paper No. 2: The Elements of Crohamhurst, 1892–1935. Pp. 17. Observatory Paper No. 3: Observations of Deep Earth Temperatures at the Botanic Gardens, Brisbane, 1928–1935, and at Crohamhurst Observatory, 1935 from 1st June; also The Sea Surface Temperatures at the Pile Lighthouse, Moreton Bay; and The Solar Constant of Radiation at Montezuma, Chile, and at Table Mountain. Compiled by Inigo Jones. Pp. 14. (Beerwah, Qd.: Crohamhurst Observatory.) [45

Česká Akademie Věd a Umění (Académie Tchèque des Sciences et des Arts). Třída 2: Anthropologica. Homo předmostensis fosilní člověk z předmostí na Moravě, 1: Lebky. (L'Homme fossile de Předmostí en Moravie, 1: Les Crânes.) By Prof. Dr. J. Matiegka. Pp. 145+16 plates. (Prague: Česká Akademie Věd a Umění.) [65

Handelingen van het Zevende Nederlandsch-Indisch Natuurwetenschappelijk Congres gehouden te Batavia van 23–26 October 1935. Pp. 771+25 plates. (Batavia: G. Kolff and Co.) [75

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des réunions. Vol. 97: The Interpretation of the Zones on Scales of Salmon, Sea Trout and Brown Trout. By T. H. Järvi and W. J. M. Menzies. Pp. 63. (Copenhague: Andr. Fred. Høst et fils.) 4.00 kr. [75

Carnegie Institution of Washington. Year Book No. 34, July 1, 1934—June 30, 1935; with Administrative Reports through December 13, 1935. Pp. xxxii+414. (Washington, D.C.: Carnegie Institution.) [85

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 16: 1933–1934. Pp. 223+vi. (Rochester, N.Y.: Eastman Kodak Co.) [85

India Meteorological Department. Scientific Notes, Vol. 6, No. 67: Measurement of Vertical Currents in the Atmosphere, mainly of Thermal Origin, with Pilot Balloons. By K. R. Ramanathan and K. P. Ramakrishnan. Pp. 213–222+2 plates. (Delhi: Manager of Publications.) 14 annas; 1*s*. 6*d*. [85

State of Illinois: Illinois Natural History Survey. Manual 1: Fieldbook of Illinois Wild Flowers. Pp. x+406. (Urbana, Ill.: Illinois State Natural History Survey.) [85

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 17: Education for Democracy; Public Affairs Forums. By J. W. Studebaker and C. S. Williams. Pp. 74. (Washington, D.C.: Government Printing Office.) 10 cents. [85

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1935. (Publication 3382.) Pp. iv+80. (Washington, D.C.: Smithsonian Institution.) [85

Smithsonian Miscellaneous Collections. Vol. 95, No. 8: Thomas Walter, Botanist. By William R. Maxon. (Publication 3388.) Pp. 6. (Washington, D.C.: Smithsonian Institution.) [85

Chinese Medical Journal. Supplement No. 1: Pathology and Microbiology; being mainly Proceedings of the Chinese Society of Pathology and Microbiology held in Canton, November 5–8, 1935. Pp. iv+518+80 plates. (Peiping: Peiping Union Medical College.) 2.50 U.S. dollars. [115

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Deuxième Série, Fasc. 3: Mélanges Paul Pelseneer. Pp. ii+1206. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [115

U.S. Department of Commerce: National Bureau of Standards. National Bureau of Standards Miscellaneous Publication M122: Weights and Measures in Congress; Historical Summary covering the Period of the Continental Congress to and including the adoption of the Joint Resolutions of 1836 and 1838. By Sarah Ann Jones. Pp. 19. (Washington, D.C.: Government Printing Office.) 5 cents. [115

Year Book, American Amaryllis Society, 1935. Vol. 2, dedicated to *Theodore L. Mead*. Edited by Dr. Hamilton P. Traub. Pp. 162. (Orlanda, Fla.: Dr. Hamilton P. Traub, Mira Flores.) [115

Koninklijke Vereeniging "Koloniaal Instituut", Amsterdam. Vijf en twintigste Jaarverslag, 1935. Pp. 125. (Amsterdam: Koloniaal Instituut.) [115

Dominion of Canada. Eighteenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement, 1934–1935. Pp. 158. (Ottawa: National Research Council.) [115

Osiris: Studies on the History and Philosophy of Science, and on the History of Learning and Culture. Vol. 2, Part 3: Sir Thomas Browne, True Scientist. By Gordon Keith Chalmers. Pp. 28–79. (Bruges: The Saint Catherine Press, Ltd.) [115

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1934. Pp. v+51. (Kingstown, St. Vincent: Government Printer.) 6*d*. [115

Tanganyika Territory: Department of Lands and Mines: Geological Division. Bulletin No. 6: Provisional Geological Map of Tanganyika with Explanatory Notes on the Geological Formations and Mineral Occurrences and a Chronological Table (provisional) of the Former. By Dr. E. O. Teale. Revised edition. Pp. iii+50. (Dar es Salaam: Government Printer.) 4*s*. [115

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen, 37: De frequentie van halowaarnemingen bij de zon in Nederland, voornamelijk van 1914–1931. By C. Visser. Pp. v+95. ('s-Gravenhage: Rijksuitgeverij.) 1.00 f. [115

Bergens Museum. Årsberetning 1934–35. Pp. 100. (Bergen: A/S John Griegs Boktrykkeri.) [125

Rules for the Grading of Teak Squares. Prepared by L. N. Seaman and V. D. Lemaye. Pp. iii+19. (Delhi: Manager of Publications.) 6 annas; 8*d*. [125

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 8: Selected Clinical Articles. 1: An Interesting Outbreak of Variola vaccinia in Milch Cattle at Lahore, by G. K. Sharma; 2: An Unusual Case of Navicular Disease, by R. L. Kaura; 3: Supernumerary Teats in Buffalo-Cows, by G. K. Sharma. Pp. iii+11+3 plates. (Delhi: Manager of Publications.) 8 annas; 10*d*. [125

Field Museum of Natural History. Botanical Series, Vol. 12: The Forests and Flora of British Honduras. By Paul C. Standley and Prof. Samuel J. Record. (Publication 350.) Pp. 432+16 plates. (Chicago: Field Museum of Natural History.) [145

Albert Nodon, In Memoriam. Pp. 28. (Bordeaux: Société Astronomique.) [155

### Catalogues

The Spekker Photoelectric Absorptiometer: an Objective 'Colorimeter' for use in Chemical Analysis. Pp. 5. (London: Adam Hilger, Ltd.)

Acriflavine 'B.D.' (Intravenous). Pp. 4. (London: The British Drug Houses, Ltd.)

Books Old and Modern, including a number on the following Subjects: Botany, English Literature and Poetry, Entomology, and Music. (Catalogue No. 245.) Pp. 20. (London: Dulau and Co., Ltd.)

Vertebrata Recentia—Fossilia zum Teil aus der Bibliothek des Herrn Baron Franz von Nopcsa, Budapest. (Antiquariats-Katalog Nr. 694.) Pp. 130. (Leipzig: Gustav Fock, G.m.b.H.)

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# Native Labour from Nyasaland

NATIVE labour, more especially after the great expansion of the mining industry, was for long one of the more insistent problems of the southern half of the African continent. Many causes combined to restrict the supply of labour, and while in time every effort was made to ensure that conditions should be as favourable to the native labourer as circumstances allowed, the authorities were even more exercised as to the means whereby the numbers seeking employment could be maintained at a figure adequate to the requirements of agriculture, mining and industry generally. After the failure of imported Chinese labour to meet this need in the early years of the present century, it became necessary for the labour-recruiting agencies to go farther and farther afield, until natives were being brought from districts very far removed from the provinces in which they were to be employed.

In these early days, the needs of industry and the call for the development of the resources of the country claimed to be, and were regarded as paramount. It was urged that any and every means, such as an increased hut tax or encouragement of the habit of purchasing European necessities or luxuries, might legitimately be used to induce or compel the native to work over and above that required for his bare level of subsistence. In justification of such argument, it has to be admitted that as the native mind has become familiarised with the idea of wage-earning, the opportunity afforded by the recruiting agent has suggested the most ready, if not indeed the only, means of meeting the deficit in the individual, or rather family, budget caused by taxation, even when it has not opened a road to the acquisition of European luxuries, or wealth in the form of cattle.

The introduction and employment of native labour on a considerable scale in the mines imposed upon the authorities the obligation to look with care to the well-being of the employed. Not only has this obligation been recognised, but also on the whole it has been met to the full, especially in the oversight of the conditions of employment, and in regard to health, housing and general welfare in the labour compounds of the mines. Yet even so, it has been recognised, as a rule, that this system of native labour entails certain consequences and changes in the character of the individual, which are not entirely beneficial, and may indeed in certain conditions be regarded as incurring the risk of inflicting positive harm.

So much may be stated, as a necessary introduction, of the case to be made out for the needs of industry and development in relation to the supply of native labour, and the obligation thereby imposed to provide some measure of protection for the labourer as an individual. There is, however, another side to the picture, which events of recent years have brought to the front. Administrative difficulties due to the loosening of the bonds of tribal custom and collective responsibility in the repatriated labourer have directed attention to the effect of labour-recruiting on the area from which labour is drawn. Africa is no more immune from the effects of labour recruitment than the islands of the Pacific, which have furnished labour for the plantations. Experience has shown that in both areas the absence of virtually the whole of the able-bodied younger men for a more or less prolonged period affects adversely the increase and the morale of the tribe, while imperilling its social and economic stability.

An example of the disturbance caused by such a removal of a large part of the able-bodied

population, and the lengths to which it may go, is afforded by the Protectorate of Nyasaland. Here, as is shown by the recently published report of a Committee appointed by the Governor in 1935 to inquire into the conditions and effects of native migration for the purpose of seeking employment abroad, the situation is such as to constitute a serious menace to the future of population and country alike. The Committee, in fact, gives warning that unless the causes of migration are controlled and counteracted, the economic entity of the country will be imperilled, large tracts of land rendered unfit for cultivation, in the native community immorality and disease will be almost universal, and the native will hate administration by white people, which has been responsible for such results.

Could an indictment more grave be framed against an administration, which, so far from being oppressive, has on the whole been well-intentioned in its aims? That such a state of affairs should now be allowed to exist, or even that such possibilities could be envisaged for the future, argues a failure to appreciate native character and custom, which should be incredible in these days of intensive scientific study of the close-knit texture of African institutions. An outworn tradition has been allowed to survive too long. Nyasaland, since the early days of labour migration in South and Central Africa, has been known as a fertile source of man-power. For twenty-five years, that is up to 1935, labour recruiting has not been permitted within the borders of the Protectorate. This policy, no doubt, at the time of its inception was thought to be in the interests of the native. It was a mistake. Although the number of the inhabitants now outside the country is not known with certainty, it is estimated that they do not fall short of 120,000. As the labourers have sought employment independently, they have lost the advantage of the organisation and safeguards which apply to the labour-recruiting agencies. They have suffered untold hardships and privations in travel; the wages offered them have been low; and they have been victimised at the hands of unscrupulous employers and others; while no arrangements have been made to remit the money they came to earn to their families, or for their own safe return to their homes. In fact, it is found that 25–30 per cent of the emigrants never return. Either they die—as they are not subjected to medical examination for fitness, the rate of mortality is high—or they marry foreign women, or they never earn, or they spend, the money they needed, and are unable or ashamed to return home.

Such are the facts which the Committee established; and on them it comments that, although the state of affairs was known to be grave, as inquiry proceeded the Committee became more and more aware that "this uncontrolled and growing emigration brought misery and poverty to hundreds and thousands of families and that the waste of life, happiness, health and wealth was colossal".

In the month of June, 1935, the Governor announced that an exclusive three-year contract had been granted to a private company permitting the engagement of labour in the Northern Province for employment in Southern Rhodesia and the Union of South Africa. It is permissible to expect that this contract will serve as a safeguard against the worst of the evils affecting the migrant labourer to which attention has been directed. Up to the present, however, it has had little effect on native migration as a whole. In probing the causes which induce the native to migrate, the Committee, while allowing something to the love of adventure, places first economic necessity. The native needs cash wherewith to pay his hut or poll tax, and as he cannot earn it locally, he must seek employment abroad.

In making its recommendations as to how the situation which has arisen may best be remedied, the Committee, in view of its findings, turns first of all to the possibility of improving the economic position of the native population by openings which would serve as an alternative to emigration. It is recommended that agricultural surveys should be made of the large areas of the Protectorate which have not yet been surveyed; and it is suggested further that the native should be trained to adapt himself and his methods of cultivation to changing conditions. The only crop, however, which it is thought would meet native requirements of a ready cash return without involving too arduous labour, is cotton. On the other hand, it is the view of the Committee that certain changes in the incidence of taxation might press less hardly on the women, and reduce migration from certain undeveloped areas. In order to control the movement of labour, a system of registration such as that practised in Southern Rhodesia, Kenya and elsewhere is recommended, or alternatively a form of tax receipt which would prove identity.

Of the Committee's recommendations, by far the most obviously attractive is that which suggests the extension of the native's economic capacity by the cultivation of cotton, although clearly it is closely bound up with a number of questions, such as transport, markets, distribution and the like, which can only be discussed after a close and detailed study of both local and extra-territorial conditions.

The importance of the labour supply in Africa suggests that the problem with which the Nyasaland Administration is faced cannot be settled finally without consideration of its ramifications outside the boundaries of the Protectorate. To deal only with its internal aspects may raise more serious issues elsewhere. One method of bringing the wider question of the supply of labour into debate is perhaps indicated by the recommendation of the Committee that, in the interest of the control of recruiting, statutory agreements should be made with neighbouring territories. Such agreements would seem to imply a thorough ventilation of the whole position. Whatever may be the ultimate decision as to the action to be taken on the Committee's report, it is clear that a perilous situation has arisen out of Government action in imposing taxation. Almost any demands on the time and thought of the Administration in finding a way out could not be regarded as excessive.

# In Search of Truth of Earth

**The Land: Now and To-morrow**
By Prof. R. G. Stapledon. Pp. xviii+336+12 plates. (London: Faber and Faber, Ltd., 1935.) 15*s*. net.

"Do you like playing with dirt? I do." (Small boy looking over rail into pit at navvy shovelling out earth.—*Punch*, April 8, 1936.)

OUT of the mouths of babes and sucklings cometh wisdom! Prof. Stapledon would have us all play with dirt. From no happier than this child's point of view can the enthralling vital message of his book be construed. He would have us all learn to know and love the land like innocent little children and be alive to its value. Strange to say, this is no matter of course. We know ourselves to be of the earth earthy; we are built of it, with sole aid of the sun, around a germinal nucleus in which lie hidden the potent templates of life; yet unfortunately we have little if any thought of our parentage. In an age nominally of great scientific progress, we are inconsiderately schooled to no useful purpose; we take no real care of ourselves, have not the slightest curiosity to know ourselves; we hand ourselves over to a control which is ignorant, mostly. As a people, we have probably gone back steadily in intelligence since the opening of our schools in 1870—because our teachers have not been taught in the right way.

"In a rapt ecstatic way", we worship the far-off heavens and are even spending two millions in making a new telescope; we jubilantly hoist the mystical electron aloft as our scientific lodestar. In real life, we rain high explosives and poison from the air upon defenceless peoples. Few give a thought for the soil: not ten per cent of our population is engaged in its service. There is nowhere a professor either of agriculture or of agricultural chemistry who is a practical farmer—with full feeling for the soil, let alone the growing plant. The seat of the academic research worker but revolves upon the laboratory stool—life in the open has neither attraction nor meaning for him. Man is not a living soul to-day. Nor will the leaf soon be allowed to show itself in vital green—under the highest scientific patronage, the poor hop is no longer allowed to grow unless plastered over with Bordeaux mixture: in fact, the vine everywhere is sicklied o'er with a by no means pale cast of vitriolic blue: the farce must soon cease or we ourselves shall be poisoned off by copper being everywhere. Natural growth is not studied: Nature is everywhere forcibly fed. The student is trained to think only in terms of statistical yields. At a college enjoying multiple county council support, trials are made year after year of the growth of barley upon laboriously randomised plots. The result is reported with great flourish of mathematical precision and calculation of probable errors in a most absurd way as the whole of such 'research' is in real error: nitrogen, we learn, in the end, is of benefit to the crop. Shade of Sir John Lawes—what say you to this?

It were time that we ceased from working at random in agriculture—that we had a clear conception what agriculture is to do for us as a nation. This, in fact, is Prof. Stapledon's main desire and purpose. As things are, we not only take no

considered notice of our land as a national possession but hide it away, more and more, with aid of tarmac, concrete, bricks and mortar. London, the greatest of our multitudinous cities, quietly allows the road engineer, the land speculator and the jerry builder to deprive it of all charm of setting; irreplaceable land of highest agricultural value is everywhere being filched from national service. Bumbledon being entirely without imagination, ignorance takes command in our councils.

The child in its innocence alone knows. Being recently sprung from the soil, he has a natural love for dirt, a desire to play with it and know it, appealing to him as it does in texture and mobility; he moulds it subconsciously, of necessity, being born to till it. Comes the day when he is sent to the prison house called school, where forthwith all knowledge of dirt is denied him by his teachers. Shut up in a featureless classroom, he is taught a worthless paper geography. His eyes are never trained to look around. The muddied oaf takes no notice of the mud with which he is bespattered; the football player knows nothing of clay more than that it is slippery. Geography should involve the study of the world at large but specially of its near details. It should begin with reasoned direct study of dirt and the land; it should not be treated as a matter of mere maps and irrelevant commercial twaddle.

In our schools the studied neglect of natural knowledge and of human needs and the failure to cultivate any faculty of contemplation are not compatible with modern life. Not until Shakespeare's incomparable lines

"And this our life exempt from public haunt
Finds tongues in trees, books in the living brooks,
Sermons in stones and good in everything"

are written up in every classroom and made to have real meaning will schools be fit training grounds for youth. A geography must be taught and as principal subject that is of real meaning. The root study will necessarily be agriculture, a discipline now entirely disregarded: hence our general ignorance of life.

Nearly forty years ago, when Christ's Hospital School was translated from crowded London City, from next door to the General Post Office and a great hospital, into the country at West Horsham, Sussex, to occupy a site before used as a dairy farm, I secured for the use of the school a well situated piece of land upon which I pictured to myself the boys might play with dirt and learn some few primary lessons of agriculture. Plots were laid down on Rothamsted lines so that the conditions of plant fertility might be studied. The first headmaster, though himself a devoted gardener, was a cleric and classic, unable to get away from tradition. The school had been wholly classical, though well spiced with mathematics, in London.

A great opportunity was lost—only a few school dullards were set to work the land; no attempt was made to bring the lessons of the plots under general notice or in any way to make the purpose clear to the school. Virgil in the study was the only approach to the plant permitted to the boys. The bursar not only gave no help but did his best to discourage the work. Later headmasters, though neither clerics nor gardeners, have been classical and perforce of the pressure of university scholarships—not one is given in agriculture—and of examinations have continued to turn but a blind eye to our effort, so that the hoped-for school patronage of agriculture is still lacking. Meanwhile, the school has developed its own dairy farm, so that the boys may have a clean supply of good milk, unspoilt by pasteurisation; a competent farm manager and estate agent has taken the place of the bursar. Some few boys have had practice on the farm, even learning to milk cows. Still, boys will be boys and play the fool when they should work, and there is more or less open contempt of their ill-directed efforts, on the farm. It is a long lane that has no turning but I shall not see this reached, as I feel it must be sooner or later: reason must prevail. None the less, near forty years is a long time to abide the coming of a little practical thought.

Systematic scientific experimental studies were first begun in Christ's Hospital two or three years before it was established at Horsham. The work was carried on most successfully during about twenty years under free conditions: latterly, the School Certificate examinations have more and more interfered with the course and the general value of the laboratory training has been steadily lowered.

This has happened in schools generally. So long as we allow an unenlightened control from outside to operate in our schools, there can be no advance: no proper training in natural knowledge will be possible. Those engaged in the work are for the most part themselves too narrowly trained and without the least imagination. When the distribution of the whisky money was first begun, not a few men of genius were engaged in the work and a whole-hearted attempt was made to develop suitable methods of teaching: their successors are more familiar with red tape, particularly in large towns such as London: only a huge administrative machine has been constructed, serving every end but the purpose for which it is nominally called into existence—"putty, brass and paint, not the work of 'thinkin'' man". If only all the official forms

are properly filled in, to be checked by a multitudinous bureaucracy, honour is satisfied. A great educational machine is created! Real machinery is put in charge of men who not only understand its working but are constantly raising its efficiency —not so the educational machine. There is no evidence to-day that its main function is supposed to be

"The makin's of a bloomin' soul".

It is difficult to say what England seems to-day: all the world is in such a muddle: blind are leading blind—most blundering of all being the universities. Research as a profession has been invented, by which attention has been withdrawn from true education. Those who fall short of learning how to pursue it, and are unprepared to take any risks, go into the schools, where they become passive resisters to the spread of intelligence—being without thought or philosophy. We cannot afford any longer to allow classical-literary authorities to mislead us into ignorance of everything we should know—to maintain the attitude that it is better to know of the past than to prepare to deal with the future. We cannot with safety allow clerical control of schools to be continued—get them to the land we must in some real way: our most vital need is to understand its value.

Prof. Stapledon maintains the thesis that, in any event, culture and land surface are interwoven and interact in countless directions difficult to unravel. To judge from the state of much of the land surface, our level of culture must be low, whatever the height. In place of culture, we have commercialism, pure and undiluted—keeping our land cultivation in general low. In large measure, King Coal has blotted out the land from our sight. Truly a nation of shopkeepers, we have subjected our farmers to a merciless competition, while protecting manufacturing industry; this at least has been the effect of free trade. Much land formerly under remunerative cultivation has been allowed to lapse to grass—without any proper care of the grass. Travelling about the country, the neglected state of our grasslands is deplorable to witness. In fact, the farmer has scarcely begun to think of grass in terms of fertility and quality—as a crop to be cultivated.

Prof. Stapledon is the apostle of grass; he has devoted his life to studying and improving it. He has proved himself an artist in grass of high and original genius. The picture he has painted, on barren Welsh hills, in grass, is fascinating beyond description: many blades have been made to grow where one grew before. The only fear is that he may brush the hills down in his ardour to develop fertility and paint them green. He is a statesman, too. One whose being is filled with a great desire to see our land properly used in the service of the nation—with absolute forethought and purpose. He would have it fully surveyed and a general policy developed, not only for agriculture, forestry and rural industries but also providing facilities in truly rural surroundings for the recreation and relaxation of the urban population. His call is to town as much as to the country. His book, in fact, is a discussion on land utilisation in general; a close national survey, no mere town planning, being advocated; it is to be studied by all who are interested in our islands from such a point of view. Hitherto, the use of land has been so little open to direction and control: it has been so entirely subject to individual ownership: that to draw up any close plan of collective action will be very difficult.

Still the writing upon the wall is clear. If only in self-protection, we shall be forced to make up our minds, without delay, to what extent we can provide ourselves with food—what we can best produce—without any regard of individual interests.

Fortunately, so great has been the advance in our knowledge of the philosophy of food, in recent years, that we can now sound a triumphant *leit motiv* to guide us on our way: we have gained a new conception of quality in food—that it involves the simultaneous interaction, in strictly balanced proportions, of a large number of unit qualities, both mineral and organic; no one of which can be omitted without harmful effect. The conviction is fast growing that most animal and plant disease is due more or less directly to malnutrition. The task now before us is to ascertain, down to the minutest details, what are the essential components of complete food and to set about producing these from the soil. Farming, at no distant date, must be the most scientific of all professions—the most highly honoured of industries. At present, we have almost everything to learn.

Prof. Stapledon's main interest lies in grass; that this will be our staple primary crop is beyond question. Still, he contemplates grass production in due rotation with other crops and, apart from the direct use to which it is put, would regard it as a means of accumulating fertility to be used at proper intervals in arable cultivation. Hitherto his work has lain in the direction of raising improved varieties, testing these mainly by the food value to sheep. More rapid, less expensive methods of testing have to be devised. The chemical issues have to be exhaustively explored.

It is clear that his plant breeding station has to be expanded into a complete organisation for the study of grass in every particular. Here is work for Mr. Lloyd George to take in hand—to develop a great Welsh institution with unfettered liberty to undertake the study of grass in every desirable

direction genius can suggest. Agricultural research has been deprived of practical value, over a long period, owing to the unfortunate policy developed by my old friend Sir Daniel Hall and the Development Commission in restricting the various subsidised stations to certain limited fields of action—Rothamsted, for example, to soil studies. I objected to this from the beginning. The result has been that we are without general knowledge of the plant, without knowledge of the animal, too, with only specialised feeling on isolated problems. If agricultural research is to be continued with public funds, it must be carried on under free conditions to a practical end. Over-lapping should be the soul of the machine, so as to give genius every opportunity to develop.

The call is for chemists—for men thoroughly trained as workers, wide in vision, with the imagination and biological feeling to woo the spirit of the land and of life as it emerges from it. The complaint is widespread that such men are not to be found. Unfortunately, the search for the chimera, not of truth, is more fashionable and attractive—far easier too. The president of the Chemical Society, at the recent ninety-fifth anniversary meeting, could only entertain his hearers with an account of modern speculation on the electronic linkages in carbon dioxide—this too at a meeting held in Bristol, where it was desirable to make clear to the public that chemistry is of all sciences the most important to the community, particularly as bearing on farming and food. The public doesn't know carbon dioxide even as the air in champagne and fizzy drinks—let alone that it is the initial fundamental raw material from which all farming starts, with the sun as ploughshare. Opportunity was there, indeed the need, to tell the wondrous story of the progress of the gas from its 3/10 thousandth state onward, which might well have been done in ultimate terms of the Clifton and Cheddar Carboniferous Gorges; cereal corn; Cheddar cheese; carrot, cabbage and cauliflower; ending in the cerebral cell and Ramon y Cajal. Instead, the Society was taken to sample chocolate! Sweetmeats, we know, are unwholesome, as they put us off our food and carry no general sustenance. Oxford hasn't enough innocence in it to play with dirt to-day. I once acclaimed it in NATURE as on the upgrade (June 16, 1904): I fear the fit is over; her chemists are now in chains, without sense of proportion.

HENRY E. ARMSTRONG.

# Finance and Industry

**(1) The Russian Financial System**
By W. B. Reddaway. Pp. x+106. (London: Macmillan and Co., Ltd., 1935.) 5*s*. net.

**(2) The Clash of Progress and Security**
By Prof. Allan G. B. Fisher. Pp. xiii+234. (London: Macmillan and Co., Ltd., 1935.) 8*s*. 6*d*. net.

(1) AS might be expected, the Russian financial system is very different from that of other countries, since the U.S.S.R. is virtually a closed economy and there are none of the semi-automatic adjustments which come about in other countries, through gold movements or through foreign exchange variations. Moreover, through its control of industry, the State is able to use the monetary system as an instrument for obtaining results which can only be achieved, if at all, in other countries, through taxation. Foreign trade is a State monopoly, and the State Bank has the sole right to deal in foreign exchange. Some foreign exchange business, however, is carried out in illegal channels through the 'black bourse', and there a more favourable rate of exchange than the official rate can be obtained for foreign currency.

Mr. Reddaway outlines very clearly and succinctly the main features of the Soviet financial system, and he has collected much information, largely through interviews with officials of the Moscow State Bank. The book provides a valuable and comprehensive survey of a subject on which little has been written. The conditions described, however, relate to 1934, except for a note dealing with the derationing of bread early in 1935. Rationing has since been abolished for all foodstuffs, and the financial system is gradually being modified in the direction of greater flexibility.

Mr. Reddaway points out that the Soviet monetary system has been developed primarily with the view of facilitating planning and production. Its main functions, therefore, have been: (1) to furnish a unit of account; (2) to facilitate the distribution of the limited supplies of productive resources to the maximum advantage; and (3) to provide an efficient means of making payments between different enterprises and for adjusting their financial relationships generally.

The interests of the consumers have been secondary, and buyers were not given a free choice as to what they might purchase in the co-operative or factory shops, where goods are sold at lower

prices to the workers privileged to hold ration cards. From the State's point of view, it could always get rid of any surplus which might be depreciating the price in the commercial shops by including it in the ration cards. The position, however, was mitigated to some extent since rations were confined to necessities which in any event would probably be bought.

(2) In a capitalist society, if a surplus is produced, it would be necessary to transfer labour and capital to other industries and occupations, and until this was done unemployment and depression would occur in the industries affected. This is a main theme emphasised by Prof. Fisher in his "Clash of Progress and Security". He is concerned with the possibility of material progress being frustrated in a capitalist economy in an effort to gain individual security. Material progress, he emphasises, means change, and this often inflicts much inconvenience and even suffering on those directly affected. He holds that the paradox of poverty in a world of potential plenty is in part to be explained by our failure to appreciate the necessity for continual changes and transfers from older industries to new industries and into types of economic activity which a less wealthy economy has been unable to afford. Prompt and continuous diversion of labour and capital into relatively new types of production is an essential condition for maintaining a satisfactory rate of material progress, as well as for avoiding chronic relapse into depression.

As the author sees it, there has been in recent years an increasing reluctance among capitalists to undertake risks: "Instead of making the bold experiments which were characteristic of the capitalist of earlier generations, he tends much more to seek security for himself by the maintenance of the *status quo*".

Prof. Fisher's book is carefully argued and thought-provoking, and should be read by all interested in these problems. K. G. F.

# Determination of Crystal Structure

**Internationale Tabellen zur Bestimmung von Kristallstrukturen:**
(International Tables for the Determination of Crystal Structures: Tables Internationales pour la Détermination des Structures des Cristaux). Band 1: Gruppentheoretische Tafeln: Tables on the Theory of Groups: Tables sur la théorie des groupes. Pp. xii+452. Band 2: Mathematische und physikalische Tafeln: Mathematical and Physical Tables: Tables mathématiques et physiques. Pp. viii+453–692. (Berlin: Gebrüder Borntraeger; London: G. Bell and Sons, Ltd.; Paris: Les Presses universitaires de France; New York: Chemical Catalog Co.; Amsterdam: N. N. Noordhollandsche Uitgevers Maatschappij, 1935.) 33 gold marks.

THE subject of X-ray analysis is difficult because it demands a knowledge of many widely different branches of science. The central problem, that of determining the relative positions of the atoms in the crystal, which in most cases includes the molecule, is obviously of supreme interest to chemistry. A new metrical chemistry is, in fact, rapidly being built up, based upon accurate measurements of interatomic distance and valency angle, which must in the future form an important connecting link between accumulated empirical data and theoretical developments. But although the subject matter is largely chemical, the investigator requires a specialised knowledge of other, and rather diverse, matters. The more abstract portions of crystallography and group theory are necessary in deriving the results, while on the practical side a knowledge of the physics of X-rays and diffraction experiments in general is desirable. It is also customary nowadays to make fairly extensive use of analysis by Fourier series in computing the more refined results, and considerable use of atomic theory is necessary in calculating the $f$-curves of different atoms.

The new international tables on crystal structure are particularly valuable because they bring together in conveniently tabulated form the essential results of these diverse sciences, thus saving much laborious reference to a scattered literature, with all portions of which no single worker can be familiar. The tables arose from the need of a standard reference work with a nomenclature to which all papers on the subject could be referred. But they achieve much more than this, because certain portions of the work have been specially prepared or computed for the present occasion, and these represent new and important contributions to scientific literature.

The first and much the larger volume contains the fundamentals of group theory and further data on the geometrical side of structural analysis. The new descriptive Hermann-Mauguin nomenclature is first explained in detail, and throughout the

work this system is used in juxtaposition with the older Schoenflies symbolism. Comparison tables of the different systems of nomenclature formerly in use are then given, and chapters on the crystal classes and translation groups and transformations follow. We then come to the main chapter dealing with the 230 space-groups, which occupies two-thirds of the volume. The description accorded to each space-group is much more complete than anything else which has appeared. The co-ordinates of the special and general point positions are given with the corresponding point symmetries and the lattice complex for each point position. The enumeration of the symmetry elements is completed by giving the screw axes and glide planes. A list of the sub-groups follows. All this information is then summarised by means of two diagrams for each space-group, one giving the general point positions and the other the distribution of symmetry elements. These pictures are greatly clarified as a result of this dual representation. The geometrical structure factor for the general plane (*hkl*) is next given, and it may be noted that this is the first time a complete set of structure factors for all the space groups has been published. They represent a valuable addition to the tools of research. The description of each space-group is completed by listing the characteristic missing spectra, or 'halving'. These lists of missing spectra are classified in the next chapter in the form of a new table by which the possible space-groups of any crystal can be determined in a systematic manner. Two further chapters on point symmetries and lattice complexes complete the first volume.

The second volume contains tables of mathematical and physical data which are of constant use in X-ray analysis: quadratic forms, trigonometrical and exponential functions, intensity formulæ, atomic scattering factors, absorption coefficients, wave-lengths, lattice constants, atomic radii, etc., and a long chapter on graphical methods of evaluating X-ray diagrams. The tables are admirably compact, and quite indispensable to anyone carrying out serious work on crystal structure.

In an international work of this magnitude which has been so skilfully planned and executed, there is little room for criticism, and we must congratulate the editors, Sir William Bragg, Prof. M. von Laue and Prof. C. Hermann, and the international group of authors on the successful completion of their immense task. The student will certainly find some difficulty with this work because portions are by no means easy to understand, although with continued use their contents may become more familiar. There is perhaps a tendency to over-elaboration in certain sections of the work. Most X-ray photographs can be analysed and the results interpreted from first principles; the use of space-group theory, for example, is important chiefly because it effects an economy of thought in presenting immediately all the mathematically possible arrangements of symmetry elements compatible with the X-ray data. But if the presentation of the theory is too elaborate the resulting economy of thought may be seriously diminished, and some workers might for a time prefer to go back to first principles rather than grapple with methods that are more complex on account of their greater generality. This criticism may apply to certain sections of the first volume, or alternatively it may be said that the reviewer does not fully understand them. The two statements are to some extent equivalent.

In minor points there are inevitably a few misprints, particularly in the second volume. We understand, however, that the publishers are preparing a leaflet of corrections. It should be noted that, contrary to the statement on p. 585, Table II, p. 588, is not based on the wave-lengths of the preceding Table I. J. M. ROBERTSON.

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### The Rise of Modern Physics

By Prof. Henry Crew. Second edition. Pp. xix + 434 + 16 plates. (London: Baillière, Tindall and Cox, 1935.) 18*s*.

THE original edition of this book, published in 1927, has been extended by about a hundred pages to deal with matters "that have only lately been reduced to order". Reference is given to the latest position of definitions of electrical units, research on the inertia of electricity, modern spectroscopy and the ether-drift problem. General corrections are made and up-to-date references to important original contributions to physics are embodied.

The author explains that the term 'modern' in the title of the book is used as opposed to 'ancient', and applies to the period since the time of Galileo. The essential object of the little volume is to present an informal connected introduction to physics, in the form of a history stated to represent the "irreducible minimum for one wishing to acquire a just perspective", with liberal references to and extracts from original sources. Actually, we are led up to modern physics, since sub-atomic research is introduced only very briefly; the older quantum theory goes as far as the Bohr atom, and the new quantum mechanics is held to be outside the scope of the book.

The whole forms a very readable and interesting discussion instead of the catalogue of facts of a conventional history. There are sixteen good portrait plates, sixteen simple line diagrams, and a few mathematical formulæ; when this is borne in mind, the price is, unfortunately, almost prohibitive to the general reader. N. M. B.

### Official Guide to the Gardens and Aquarium of the Zoological Society of London

By Dr. Julian S. Huxley. New Series. Pp. 116. (London: Zoological Society, 1936.) 1*s*.

THE new guide to the gardens of the Zoological Society, by Dr. Julian S. Huxley, the secretary of the Society, forms a sharp and striking contrast with the stereotyped form which has done duty for so many generations of visitors. As a guide for those who wish to see the Gardens in one visit it has lost nothing in efficiency compared with its predecessors.

But at the end of their visit they will, almost certainly, carry this little booklet home with them, to read again at leisure, when they will discover how much there is to *learn*, as well as to see, during future visits. These pages, indeed, will open up an entirely new conception of the part the Gardens play as a source of information concerning the animals exhibited here, drawn from the ends of the earth; for compressed within a few pages they will find unsuspected interest concerning their geographical distribution, the marvellous way in which they have become moulded by their mode of life, and something of the meaning of the classification of animals.

W. P. P.

### Man who could work Miracles

By H. G. Wells. A Film Story based on the Material contained in his short story "Man who could work Miracles". Pp. 96. (London: The Cresset Press, 1936.) 3*s*. 6*d*. net.

IN this film story Mr. H. G. Wells applies again the treatment used in "Things to Come" to material drawn from the fantastic vein of his earlier works. He describes how a draper's assistant in a small town suddenly becomes endowed with miraculous powers, how he uses his newly acquired gifts to further his own desires or those of friends, and how he loses his gift with dramatic suddenness just as he involves the world in disaster. Mr. Wells uses his new technique to expound his familiar theme of man's inability to use wisely the powers with which science has endowed him, and to bring into high relief the moral as well as the material obstacles which beset the transformation of the present situation of unemployment and impoverishment in the midst of overproduction and sabotage into an era of peace and plenitude for all.

### A History of Gardening in Scotland

By E. H. M. Cox. Pp. xvi + 229 + 20 plates. (London: Chatto and Windus, 1935.) 12*s*. 6*d*. net.

THE ten chapters of this book show that all aspects of the subject have been given due attention, ranging as they do from the earliest times to the accession of King James VI; the start of the country house; the age of the formal garden; the natural type of garden; the Victorian garden; botanic gardens; seedsmen, nurserymen and market gardens; college gardens; horticultural societies and flower shows and the gardener.

Early records are very few and uninteresting; they serve to show, however, that such cultivation as existed in the earliest times was almost exclusively fostered by the many monastic establishments. The unsettled state of the country and the lack of any security of land tenure in the earlier days did little or nothing to encourage either horticulture or agriculture in Scotland.

Not the least interesting portion of the book is the various lists of hardy fruit commonly grown, also lists of orders for vegetable seeds. We need only mention one dating back to 1689 which shows a surprising variety for that period.

There are several appendixes, a glossary and bibliography. There are also two good indexes, one devoted to the names of places—a valuable innovation.

More than twenty excellent illustrations add materially to the charm and interest of an attractively produced book. It should have a wide appeal to all interested in the history of gardening in Scotland, which, for many years, has been noted for the high cultivation of its gardens under often somewhat difficult climatic conditions, to say nothing of the fame of the Scottish gardener, which is world-wide.

### Notes on Organic Chemistry

By Prof. F. Francis. Pp. viii + 525. (London: Edward Arnold and Co., 1935.) 12*s*. 6*d*. net.

THIS book is on novel lines, and is likely to be of great use to honours and research students as well as to lecturers and workers in organic chemistry. The author sets out in short crisp paragraphs notes on a large variety of pertinent subjects. These include organic reactions, the hydrocarbons, their halogen derivatives, the reactions of unsaturated substances, oxidation and synthetic methods. The subject matter is printed on one side of the page only so that the worker can add his own notes. References are given to other sources of information, in particular to summary articles.

The book forms a mine of information gathered over many years by one who has high repute as a teacher and worker, and should prove a great saver of time to its possessors. Its price is remarkably reasonable.

### Steel and its Heat Treatment

By D. K. Bullens. Third edition, rewritten and reset. Pp. xiii + 580. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

THE only addition to this issue of "Steel and its Heat Treatment" is a chapter on nitriding, contributed by Dr. V. O. Homerberg. In the space of sixteen pages a brief outline is given of the nature and conduct of the nitriding process, of the steels suitable for nitriding, and of their properties after treatment. Otherwise the book remains the same, although eight years have passed since the preparation of the previous edition. There is still, therefore, no reference to the notched-bar impact tests to which British metallurgists rightly attach so much importance, to grain size control (although this originated in America), to the newer types of stainless steels, or to manganese-molybdenum steels.

# Modern Developments in the Design of Aeroplanes*

## Scientific Research and the Problems of the Future

PREVIOUS James Forrest lectures summing up the then situation in aeronautics were delivered by Dr. F. W. Lanchester in 1914 and Prof. R. V. Southwell in 1930. It is curious that the scientific development of the aeroplane has fallen into phases that appear to correspond with these dates. From 1914 until 1930, the aero-engine made the more marked progress, but since that date advances in aerodynamic efficiency of aircraft have been the outstanding achievement. General aerodynamic improvement has been compounded of a number of more or less independent steps: better shapes of wings and bodies; smoother surfaces and the elimination of discontinuities in those surfaces; reduction of excrescences; closing over of openings such as cockpits; retraction of undercarriages; and improvements in means of engine cooling.

Comparing the De Havilland "Comet" and the Heinkel "He 70", the outstanding machines of 1935, with a good example of 1930 design, the drag coefficients for wing area and total 'wetted' area of the whole machine have been reduced to less than half their best value in 1930. The combination of this reduced resistance with higher powered modern engines has raised speeds from 170 miles per hour, quoted by Southwell in 1930, to more than 300 miles per hour to-day.

A great deal of this advance has been due to a more complete appreciation of the basic problem of aerodynamic effects, consequent upon the introduction of the compressed air wind tunnel. This has enabled phenomena to be studied over the whole range of Reynolds numbers, between that in an ordinary atmospheric tunnel, and that of full-scale flight. A typical case of this kind is that of the effect of surface roughness on drag, from which it has been established that, at speeds now reached, the surface roughness, due to the almost universal practice of covering aircraft wings with fabric, has an effect large enough to be intolerable.

This increase in top speed has brought its own problem, in that the minimum speed at which the machine will remain air-borne, that is, the landing speed, *may not rise* with it, because of safety requirements during landing and taking off. Handley Page slots, or trailing edge flaps, although their effect is basically different, both have the desired effect of delaying the 'stall' to safe speeds, and the appropriate use of either one, or a combination of both, appears to give such extra speed range as is necessary.

Another problem that has been attacked since its physical basis has become better understood is that of 'interference'. For example, the combination of a body and a wing, both separately of low drag, in such relative positions as practice demands for a low-wing monoplane, may give in total a high drag due to interference. It has been improved by filling in the regions of divergent flow with 'fillets'. The extra advantages due to having a short, easily retracted undercarriage, and the improved landing conditions due to the 'cushioning' of the air beneath a wing, close to the ground, more than compensate for the little remaining aerodynamic inferiority of this over other arrangements of wings and bodies.

Great advances have also been made in the problem of engine cooling, and the state of knowledge is now such that even further progress may be expected in the near future. The liquid-cooled engine may use retractable radiators, drawn progressively inside the body at higher speeds or when the temperature of the air falls, when the cooling is more effective. Alternatively, portions of the aeroplane's surface may be given a double skin between which a thin layer of liquid circulates, as developed for the machines in the Schneider Trophy race, which gives cooling for practically no drag. For air-cooled engines the "Townend Ring" and the "N.A.C.A." cowling can now be so designed that they not only give properly distributed and controlled cooling to the engine, thus increasing its efficiency, but also it is possible to visualise the exhausted cooling air being so directed that it adds to the propulsive force of the airscrew. Thus a cooling drag of a negative value will be possible, as compared with 6–10 per cent of the brake horse-power of the engine lost in measured cases of fairly recent machines.

Improvement of the airspeed of flying-boats and seaplanes is hampered by the necessity for good water performance. The best shape of floats and hulls for landing and taking off does not usually give low air drag. Further, either wing tip floats or stub wings are needed to give stability when afloat, and these are not so easy to retract as the corresponding undercarriage of a land machine. A certain part of this inevitable inferiority in performance is regained in that such a machine has

* Substance of the forty-second James Forrest Lecture delivered at the Institution of Civil Engineers on May 5, by E. F. Relf, superintendent of the Aerodynamics Department, National Physical Laboratory, Teddington.

larger surfaces from which to manœuvre, and consequently can have a higher minimum speed.

This increase of top speed, coupled with the extension of speed range, has brought many minor troubles that have called for special scientific investigations. The difference between minimum 'take-off' speed and normal 'cruising' speed is now so marked that a variable pitch propeller is necessary if maximum efficiency is demanded under all conditions. This has proved to be practicable in metal, but up to now is about three times the weight of a fixed pitch wooden airscrew. Servo-assisted controls are often necessary on both large and fast machines, and the correct relationship between aerodynamic balance, servo-action and manual operation of the various control surfaces, and their correlation with each other, is not easy to establish.

Considering the future, there are three main lines of progress: further reduction of drag, reduction of structure weight and improvement in engine performance. The margin between the present attained minimum drag and pure skin friction is small, and no great improvement in this is likely unless some revolutionary discovery points to a means of compelling the boundary layer flow to remain laminar over a much greater portion of a surface. Also as the speed of a body approaches the speed of sound in air the effect of compressibility causes a rapid rise in drag. The world's speed record is already six-tenths of the speed of sound. The problem of cooling will also be complicated by the natural rise in temperature of a body moving rapidly through air. Reduction of structure weight of a large order does not seem probable, unless research in atomic physics brings the production of synthetic materials with properties vastly superior to those in use at present. Improvements in engine performance will only be of a detailed order, unless something revolutionary in the manner of converting the latent energy in fuel into power is discovered.

# Light and Temperature and the Reproduction of Plants*

By Prof. V. H. Blackman, F.R.S.

THE path of the plant physiologist who sets out to make accurate measurements of the effect of light and temperature on the growth and multiplication of the plant is beset with many hindrances. In the first place, the plant, the system which he investigates, is never completely reproducible. No two living things are exactly alike, and the variability of the biologist's material is an ever-present threat to the accuracy of his work. Something can be done to reduce the variability by selecting the progeny of a single individual, using clonal or pure-line plants. After the most careful selection, however, some variability inevitably remains; this must be evaluated by statistical methods.

## EFFECT OF LIGHT

With the study of the influence of such an external condition as light, other difficulties arise. Sunlight, as we receive it, is inconstant in quantity and variable in quality. In exact studies of the action of light which are to last for more than the briefest period, one must inevitably resort to artificial sources of illumination, since they alone can be held constant for long periods. Unfortunately, electric light sources, though wanting nothing in steadiness, are very different from sunlight. No illumination engineer has yet achieved the 100 per cent efficiency of the 'cold' light of the glow-worm which includes no heat rays. Caution must therefore be exercised in applying to plants grown under natural conditions the physiological results obtained with artificial light sources.

Although in experimental work the constancy of the illuminant can be assured by the selection of artificial light, the uniformity of illumination of the whole plant surface is much more difficult of accomplishment. If the light source is removed so far from the plant that its upgrowth results in no marked difference of intensity between the upper and lower portions, then the illumination received is generally of too low intensity. When considering this difficulty some ten years ago, it was evident that the need was for a plant which had no upward growth but spread only horizontally. It was then realised that, in the ordinary duckweed (*Lemna minor*) of our ponds, Nature has provided such a plant. From that time onward, the physiological behaviour of this plant has been intensively studied in the laboratories of the Imperial College of Science.

By placing the plant under carefully controlled conditions, a regular, continuous growth can be

* Substance of the Friday Evening Discourse delivered at the Royal Institution on February 21.

ensured, and the effect of light and temperature upon it can be followed very simply. One has only to start a culture with a certain number of fronds, the frond being the unit of growth, and count every day the number of fronds present and so find how favourable or unfavourable are different temperatures and different light intensities for its multiplication.

The question arises as to the measure of the rate of multiplication to be employed. It is evident that as all fronds are multiplying, the more fronds there are at any given moment the more will be produced—in other words, the number produced in the culture during any given period is dependent upon the number existing in the culture at the beginning of that period. The multiplication of duckweed thus obeys the 'compound interest law', and can be expressed in a simple mathematical way. With money at compound interest the interest is added periodically, usually at annual periods. Nature, however, does not usually work spasmodically, so we find that as duckweed grows steadily in continuous light the new material which results is added continuously.

With the new material added continuously, the relation between the number of fronds at the beginning and end of any given period can be expressed by the equation $N_t = N_0 e^{rt}$ where $N_t$ is the number given at the end of the period $t$, $N_0$ the initial number, $r$ is the rate of compound interest and $e$ the base of natural logarithms.

TABLE I

| Day. | Frond numbers. Observed. | Calculated. |
|---|---|---|
| 0 | 100 | 86 |
| 1 | 127 | 122 |
| 2 | 171 | 173 |
| 3 | 233 | 245 |
| 4 | 323 | 368 |
| 5 | 452 | 493 |
| 6 | 654 | 699 |
| 7 | 918 | 990 |
| 8 | 1400 | 1404 |
| 9 | 2150 | 2137 |
| 10 | 2800 | 2822 |
| 11 | 4140 | 4001 |
| 12 | 5760 | 5672 |
| 13 | 8250 | 8042 |

Table I from the work of Ashby and Oxley in the Imperial College laboratories shows the rates of multiplication observed and those to be expected if the rates are perfectly regular; the temperature was 24° C. and the illumination 500 foot-candles. The discrepancies between expectation and performance are only slight.

Using the formula applying to the increase in frond number or the relative multiplication rate we find in another experiment, one by H. L. White, that $N_t = N_0 e^{0\cdot 349t}$ where $t$ is measured in days. The rate of interest was 34·9 per cent per day; this implies a speed of duplication of almost exactly two days, actually 1·99 days. Starting with a hundred, one would at this rate achieve a million in a little more than twenty-six days. For a flowering plant this rate is sufficiently remarkable; it is, however, nothing to that of bacteria, which may double their number every half-hour and so increase from a hundred to a million in about seven hours. If not the actual numbers but the logarithms of the frond numbers are plotted against time, then with a perfectly regular multiplication rate, all the points should fall on a straight line. In Fig. 1, from Ashby and Oxley's results, it is seen how closely the points correspond with a straight line. It is a curve such as one would expect in a purely physical or chemical experiment; it shows how by using the greatest care biological material may be made to yield data of very high accuracy.

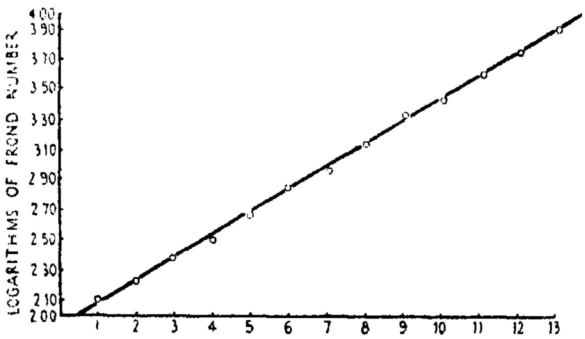


FIG. 1. Logarithms of frond number of *Lemna minor* plotted against time in days. The figures are taken from an experiment at 24° C. and 500 foot-candles. The straight line drawn through the points corresponds to the equation $y = 0\cdot152x + 1\cdot935$. (From Ashby and Oxley.)

One of the most surprising products of the work on duckweed is the discovery of the very low light intensity to which it is attuned. When one considers that the duckweed floating on the surface of the water is often exposed to direct sunlight with a brightness of many thousand foot-candles, it is unexpected to find that *above* 750 *foot-candles increase of intensity has no value*. At 1,400 foot-candles, far below direct sunlight, there is even an injurious effect.

A marked difficulty of research in plant physiology which is not met with in physical and chemical work is the change in the plant as we subject it to different conditions; the system we are studying is altered by the experimental conditions to which we expose it. With high light intensities we get thick fronds and with low light intensities thin ones, just as with sun and shade leaves in our gardens.

Another interesting phenomenon has come to light. As is well known, the green plant is dependent on light for the manufacture of its food materials, which are produced from water and the carbon dioxide of the air by the process of photosynthesis. Since multiplication of the plant requires a supply of new raw material, it might

be expected that the rate of multiplication would be dependent on the rate of photosynthesis. One finds, however, that there is no close relationship between the two. For example, they respond very differently to the effect of light intensity; rate of photosynthesis is still rising at a brightness of 1,600 foot-candles while the multiplication rate ceases to increase above 750 foot-candles. Light therefore affects the multiplication rate not only through food supply but also directly.

So regular is the growth of the plants under carefully controlled conditions that one can use the compound interest principle in the study of a *deleterious* factor. In some experiments, also by H. L. White, in which the plants were starved of potassium, an element essential for their growth, it was found that the growth-rate fell off at a constant rate as starvation set in. Thus with full nutrition the rate of compound interest was 33 per cent per day, while under potassium starvation this rate fell off at a rate of 15 per cent compound *decrement* per day.

### PHOTO-PERIODISM

If we turn our attention to plants which reproduce themselves not by budding, as in duckweed—a process of vegetative reproduction—but by sexual reproduction, that is, by the function of flowers and fruits, we find again that light and temperature have profound effects.

Light is, of course, necessary for the unfolding of the flower buds, and often for their growth, but of recent years a much less obvious relationship has been established between light and the flowering of plants. It is, of course, well known that we have spring-flowering plants like *Viola*, *Anemone* and *Hepatica*, autumn-flowering forms like *Chrysanthemum*, *Nicotiana* and *Dahlia*, and numerous plants which flower in the summer. It used to be assumed that the time of flowering was determined by the temperature or by the relationship between temperature and intensity of light. The actual controlling factor was determined only in 1918 in the United States. A certain giant variety of tobacco, grown in Maryland, known as Maryland Mammoth, generally failed to flower or was cut down by frost before it had seeded. It could not therefore be multiplied by seed. In 1918 a potted plant of this variety happened to be brought into the greenhouse in the autumn. Protected thus from the frost, it flowered in November and later set seed. Experiments were then made with seedlings, and it was found that if seeds were sown in the autumn in the greenhouse they flowered very early, but if sown in the spring the plant grew vegetatively throughout the summer, only flowering in the autumn. Close investigation showed that the effect was due neither to temperature nor to light intensity, but the flowering was a response to the brevity of the autumn day. The plant is a *short-day* plant, that is, it will only flower if exposed to days of not more than 12 hours. Such plants when grown in temperate conditions flower only in the autumn or spring. To this class belong *Nicotiana*, *Cosmos*, *Poinsettia*, some species of *Ipomœa*, *Bougainvillea*, and the sub-tropical cereals such as maize, sorghum and other millets. With some varieties of soybean such as Biloxi the time to flower can be shortened from the 120 days required under normal conditions of summer illumination to 28 days when the period of daylight illumination is artificially shortened to 12 hours.

Sharply contrasted with these are the *long-day* plants which require for flowering a period of 14–15 hours, and thus bloom normally in the long summer days. To this group belong the spring varieties of the temperate cereals, runner beans, red clover, garden pea, lettuce, potato, the evening primrose, *Cassia*, *Sedum*, *Rudbeckia*, etc. Garner and Allard, who were the first to discover this response of flowering to length of day, have termed it *photo-periodism*.

Valid generalisations in biology are notoriously difficult of attainment, so that one is not surprised to find that there are many other plants which are so moderate in their demands that they may be described as indeterminate; they flower in both long and short days. To this class belong many widely distributed weeds, such as dandelion, chickweed and groundsel. In the tropics only short days are available, whereas in high latitudes short days are only available at times at which the temperature is liable to be too low for flowering. A plant to be useful both in the tropics and under outdoor conditions in high latitudes must be indeterminate in its light needs, that is, show no photo-periodic response. Plants like *Poinsettia* and *Bougainvillea*, which come from Central America, if they are to flower can tolerate no more than 12 hours of light. In our latitudes therefore they have no horticultural value except under warm greenhouse conditions, since they flower in the autumn and winter.

Viewed from the angle of the horticulturist, photo-periodism is of great interest, for it places in his hands a new power of control. By the use of artificial light for lengthening the period of illumination in spring and autumn, 'long-days' can be provided for flowering out of season. Similarly, by reducing the day to one of ten hours by the protection of the plants from light during a portion of the day, autumn blooming can be induced in summer. In the case of Maryland Mammoth tobacco, once the secret of its sterility had been penetrated the economic problem was easily

solved. Seed production is achieved in Florida where there are short days without the rigours of an autumn climate.

To the plant physiologist, on the other hand, photo-periodism presents a most baffling problem. When considering a reaction in the plant induced by light, he attempts at first to interpret it in terms of chemistry and therefore expects the 'product law' to hold. The effect should depend on the quantity of light energy received, and so should depend both on the time of exposure and the intensity of light. With the photo-periodic reaction we find no such relationship. It might be thought at first sight that the long-day plants require a greater light-supply for their flower formation than do the short-day ones. But this cannot be the explanation, for with long-day plants an exposure to a 10-hour day can be continued for a period which will give a total light supply much higher than is given by an exposure to a 14-hour day; yet flowering will result in the second case and not in the first. *Duration of illumination* rather than quantity of light is the important thing, and this is exceedingly difficult to interpret in terms of physiology. In the case of short-day plants there is some reason for believing that it is the corollary of the period of illumination, namely, the *period of darkness*, to which attention should be directed.

*(To be continued.)*

# André Marie Ampère, 1775–1836

By Dr. D. McKie, University College, London

ANDRÉ MARIE AMPÈRE was born in Lyons on January 20, 1775, and died at Marseilles on June 7, 1836. His early childhood was spent in the country near his birthplace and his first studies were directed by his parents. A childish pastime of carrying out complicated arithmetical calculations with little pebbles was prophetic of his future devotion to mathematical studies, a devotion that was evidenced again when his father, a retired merchant, began to teach him Latin; for the young Ampère quickly showed his great preference for mathematics, whereupon his father wisely allowed natural inclination to take its own course, providing the necessary introductory works from his own small library. But when these had been mastered, more advanced reading was necessary; and it is recorded that, at twelve years of age, Ampère, accompanied by his father, went to ask in his piping boyish voice for the loan of the works of Euler and Bernoulli from the College Library at Lyons. He appears to have mastered these classics also; and he read widely in the literary, historical, scientific and philosophical authors of his country. In fact, like a recent Lord Chancellor of England, he turned to the current encyclopædia, in his case that of Diderot and d'Alembert, to equip himself with the accumulated knowledge of the ages; and a half-century later he was able to recite from memory whole passages from the famous "Encyclopédie" that expressed the genius of eighteenth century France.

Ampère's extraordinarily rapid intellectual development was, however, interrupted by the tragic death of his father, executed in 1793 as a victim of the Revolution. The shock of this event left Ampère bereft of all his faculties for a whole year, in which he is said to have done nothing but play childishly with heaps of sand and gaze vacantly at the sky, until by a fortunate chance he picked up Rousseau's "Lettres sur la botanique", the reading of which revived his interest and carried him back to his scientific studies. He now began to teach mathematics; and shortly afterwards, in 1801, he was appointed to the École centrale at Bourg. In 1803 he became professor of mathematics at the Lycée in Lyons. But in 1805 his increasing reputation carried him to an appointment at the École polytechnique in Paris, where he was appointed professor in 1809. He was elected to the Academy in 1814, and in 1824 he became professor of physics at the Collège de France.

In August 1799 Ampère contracted a happy but short-lived marriage with Mlle. Julie Carron, the daughter of a devout neighbouring family. The family were not over-blessed with this world's goods, but in their company Ampère appears to have found his spiritual ease, possibly through their reflection of his own natural piety, his religion throughout his life being something totally apart from his scientific interests and speculations. The only child of the marriage, a son, Jean Jacques, was born in 1800 and became a professor at the Collège de France and a member of the Academy. Mme. Ampère died after prolonged illness in 1803, some short time after Ampère had returned home from a separation enforced by his teaching duties elsewhere; and it is fortunate, having regard to the

severe consequences of the first, that Ampère was able to withstand this second tragedy of his early years as no more than a great and lasting grief.

Ampère's first scientific contribution, which dealt with the mathematical theory of games of chance, was published at Lyons in 1802. It attracted the attention of Delambre, and thereby led to Ampère's appointment at the Lycée. From then onwards Ampère published numerous memoirs on mathematics, physics and chemistry. But his classical work lay in the field of electro-magnetism, and it is for these researches that he is remembered as the father of electro-dynamics. His work here followed almost immediately on the announcement in July 1820 of the discovery by Oersted ("Experimenta circa Effectum Conflictus Electrici in Acum Magneticam", Copenhagen, 1820) that an electric current affected a magnetic needle, in brief, the discovery of electro-magnetism and the demonstration of the long-suspected connexion between electricity and magnetism. Many physicists turned their attention to this remarkable discovery, but it was Ampère who proved most successful; and in September of the same year he read before the Paris Academy of Sciences the first of a series of papers, setting out his own discoveries in electro-dynamics, including more notably the laws governing the deflection of the magnetic needle with regard to the current and the mutual attractions and repulsions of electric currents.

In 1822 Ampère presented to the Academy his mathematical analysis of these phenomena, confirming his studies in 1827 in his "Mémoire sur la théorie mathématique des phénomènes électrodynamiques uniquement déduite de l'expérience", showing that an electric current is equivalent in its external effects to a magnetic shell, and propounding the theory that magnetism is the result of molecular electric currents. Of this work Arago wrote: "The vast field of physical science perhaps never presented so brilliant a discovery, conceived, verified and completed with such rapidity". And much later Clerk Maxwell said: "The whole, theory and experiment, seems as if it had leaped, full grown and full armed, from the brain of the 'Newton of electricity'. It is perfect in form, and unassailable in accuracy, and it is summed up in a formula from which all the phenomena may be deduced, and which must always remain the cardinal formula of electro-dynamics."

Among other interesting details of Ampère's scientific work, it might be noted that he devised astatic needles, formulated the well-known 'Ampère's Rule' for determining the deflection of a magnet by an electric current, suggested the electric telegraph as an application of Oersted's discovery, published an "Essai" (1834) on the philosophy and classification of the sciences, and expressed, unaware of their earlier publication, ideas similar to those expounded in Avogadro's hypothesis. Moreover, he was opposed to the caloric theory, regarding heat, as well as light, as the result of vibratory motion.

For his epitaph, Ampère chose the words *tandem felix* (happy at last). In France, the centenary of his death has been marked by the issue of a commemorative stamp and by an exhibition in his native city of Lyons. In the world of science he is remembered daily, the 'ampere', the practical unit of electric current, perpetuating his memory.

# Obituary

## Prof. A. C. Dixon, F.R.S.

PROF. ALFRED CARDEW DIXON, who died suddenly on May 4, at the age of seventy years, at his home in Northwood, Middlesex, was a mathematician of great ability and power, with a high reputation, founded, in the first place, on his brilliant Cambridge record, and steadily built up by a lifetime of research on a most unusual variety of mathematical topics.

As a student at Cambridge, Dixon's name, from all accounts, was one to conjure with; and he was perhaps best known to the public as the Senior Wrangler of 1886, who had the reputation of being unbeaten in any examination for which he had ever entered. He was a fellow of Trinity College, Cambridge, a fellow of the Royal Society; and on his retirement, after thirty years' service, from the chair of mathematics at the Queen's University, Belfast, he settled down in Northwood; he was elected president of the London Mathematical Society for the period 1931–33.

In private life, Dixon was as quietly simple and sincere as he was distinguished in public life; and this kindly simplicity and sincerity endeared him exceedingly to all who came much in personal contact with him. He was by persuasion a Methodist, and took a deep and lifelong interest in all the affairs of his church; and he was passionately fond of music and for many years an enthusiastic performer in the Philharmonic Orchestra, Belfast.

In his original work, Dixon contributed to many fields, and to every one something of strength and value. His earliest interests were partly geometrical; and his researches on plane cubics, the double-six

configuration, and the cubic surface have left a permanent mark on the subject. In algebra he contributed to the theory of canonical forms of ternary and quaternary quantics. In analysis he was an authority on elliptic functions, his book on this subject being an original and elegant introduction to the general theory; and he contributed also on various other topics, touching even on the calculus of variations. But the problem which gave direction and stimulus to his best work in later years was that of the rectangular plate, which led him far into pioneering work on integral equations. This problem, as to the deflection produced at any point of a thin rectangular plate, clamped round the edges, by a load concentrated at one point of the plate, was brought to his notice by the professor of engineering at Belfast; and in it Dixon found an elusive and tantalising quest, after his own heart, and one which led him further afield into researches, of no immediate interest, it is true, to the engineer, but of great interest indeed to the pure mathematician. It was this problem, the partial progress made, and the methods which might lead to a complete solution, which formed the subject of his presidential address to the London Mathematical Society in 1933.

In the field of mathematical problems and recreations, also, Dixon contributed to the famous fifteen school-girls problem and to the problem of colouring a map; and at the end of last century he was setting, in entrance scholarship papers in Galway, 'shadow' division sums of the type that attained such widespread popularity later as mathematical conundrums.

As a teacher, Dixon was particularly invaluable to his advanced students on account of the breadth of his knowledge, and because he had the unusual gift of having it all ready to hand all the time—he never seemed to get 'rusty' on any branch he had ever studied. On the other hand, he never gave one the impression of great erudition; he seemed indeed, on the contrary, to prefer to trust to his own amazing resourcefulness in attacking any problem rather than spend a long period in gaining a comprehensive knowledge of all the contributions of others to its solution. His lectures were models of conciseness and economy of effort; and the quiet and imperturbable way in which he delivered them caused him to be known among his students at one period as 'the leisurely professor'. Even the weakest of his students, however, though he might find Dixon's lectures very hard going, always instinctively recognised and respected his greatness as a scholar and a man.

Science has lost in Dixon an eminent mathematician, who has justly been described as one of the last, if not the very last, of the great 'all-rounders'; and his many pupils and former colleagues will greatly mourn the loss of a stimulating teacher and a loyal friend.

J. G. S.

## Mr. J. Whitehead, K.C.

THE death of Mr. James Whitehead, K.C., on April 3, has removed an outstanding figure among those whose work lay in the exposition of scientific matters. He had for many years occupied a predominating position in technical cases which came before the Law Courts, and was engaged in numerous actions where complicated scientific phenomena have had to be explained to tribunals little conversant with such matters. For this work he had peculiar and striking gifts. He was able to make difficult and unfamiliar scientific ideas not only intelligible but also even fascinating, and it was this faculty which contributed largely to his success at the Bar.

Mr. Whitehead was, however, in addition, by reason of his critical and logical mind, a skilled—though always a quiet and courteous—cross-examiner of scientific witnesses. As a man he was distinguished by his courage and kindliness and by his wide sympathies and interests. In spite of the exacting character of a heavy practice he was always willing to place his knowledge and experience at the service of the public, particularly in relation to education in science and in the law, notwithstanding the fact that for many years he had to carry on his work under the burden of indifferent health.

James Whitehead was the eldest son of J. R. Whitehead, of Padiham, Burnley. He entered the Royal College of Science with a scholarship in October 1896, and in June 1899 became an associate of the Royal College of Science in chemistry. After a period of a year as student demonstrator in the Chemistry Department of the College, he became science master at Berkhamsted School, which position he held until the year 1911. He was called to the Bar in 1910 and began active practice in 1911. He took silk in 1923 and was elected a bencher of Gray's Inn in 1924.

Outside his chosen profession, Mr. Whitehead's activities were numerous. He was one of the first nine fellows of the Imperial College of Science elected in 1932, was a member of the governing body of the College for some years, and was a representative of the legal profession on the senate of the University of London. He served as a member of the Board of Trade Committee on the amendment of the Patents and Designs Act under the chairmanship of Sir Charles Sargent, and took a prominent part in the proceedings of the International Association for the Protection of Industrial Property, and was chairman of the British group when the International Conference of that body was held in London. In December of last year he became chairman of a committee of investigation into the milk trade under the Agricultural Marketing Act in succession to the late Mr. Edward Shortt, K.C. This inquiry continued until February of this year, and he had barely completed the report on the inquiry when he was stricken with the illness which in a few days caused his death.

Mr. Whitehead leaves behind him to his many friends both in the legal profession and in the scientific world the memory of a man of rare character and intellectual ability, and of a kindly, generous nature, whose wide sympathies and eager enthusiasm for, and knowledge of, many diverse subjects rendered him a most interesting and delightful companion.

## Sir Frederick Macmillan, C.V.O.

THE death of Sir Frederick Macmillan on June 1, at eighty-four years of age, ends a remarkable triumvirate in the history of the firm of Messrs. Macmillan and Co., Ltd., the publishers of NATURE ever since it was founded by them and Sir Norman Lockyer in November 1869. At that time the firm consisted of Mr. Alexander Macmillan, who died in 1896, and Mr. George Lillie Craik, who died ten years later. During their lifetime three other partners were admitted—Frederick Orridge Macmillan (1874), George Augustin Macmillan (1879) and Maurice Crawford Macmillan (1883).

By a most tragic set of circumstances, these three directors have all passed into silence within a period of three months. Mr. George Macmillan died on March 3, Mr. Maurice Macmillan on March 30, and on the day of his brother's funeral Sir Frederick slipped on the floor of his dressing-room and this accident led to his death on Monday last.

Sir Frederick Macmillan began his training as a publisher at Cambridge, and then went to New York where a branch house was opened in 1869. He was away for five years before returning to settle finally in the London office. In 1890 the New York branch was constituted on an independent basis as The Macmillan Co., and in 1896 the London firm became Messrs. Macmillan and Co., Ltd. Sir Frederick Macmillan succeeded Mr. G. L. Craik as chairman of directors in 1905, and occupied that position until his death.

It is recorded in Mr. C. L. Graves's "Life and Letters of Alexander Macmillan" that "Sir Norman Lockyer had an absolutely free hand in reviewing books published by the firm, and never hesitated to criticise them adversely if he thought they deserved such treatment". To scientific readers it may seem unnecessary to refer to such editorial freedom; for reviewers pay little attention to the names of publishers, and would resent any suggestion as to the character of notices required of books submitted to them. It is, however, only just to testify that throughout the experience of the present Editor of NATURE, extending over forty-three years, neither Sir Frederick Macmillan, nor any other of the directors, has ever intervened in the editorial conduct of the journal. Only men with high ideals and broad outlook could take such an attitude towards a publication issued by them; and we gladly pay tribute to it.

NATURE would never have survived its early years if the publishers had regarded it merely as a business enterprise; for it was carried on for thirty-two years at a financial loss, and not until 1902 did the returns show a small profit. Sir Frederick Macmillan, who was the head of the firm for so many years, maintained this enlightened policy with unwavering support; and grateful acknowledgment may therefore be made appropriately in these columns of the important part he played in rendering the journal independent of considerations—financial and otherwise—which have often prevented other scientific periodicals from reaching maturity.

Sir Frederick Macmillan followed with close attention the main developments of science recorded in these columns, and his personal friends included many workers in scientific fields of the past and present generations. He took an active part in a number of public and philanthropic organisations, among them being the Royal Literary Fund and the National Hospital for Diseases of the Nervous System, of which he was chairman of the Council of Management. He received the honour of knighthood from King Edward VII in 1909, when the jubilee building of this hospital was opened, and was created a C.V.O. in 1928. He will be sadly missed by a large circle of friends, and the memory of his fine figure and stimulating influence will long be cherished with affection by all who came into contact with him.

## Mr. H. G. G. Payne

MR. HUMFREY PAYNE, director of the British School of Archæology at Athens, died on May 8 at the age of thirty-four years. Humfrey Gilbert Garth Payne was born in 1902, the son of Mr. E. J. Payne, fellow of University College, Oxford. He was educated at Westminster School and Christ Church, Oxford, holding an open scholarship of the latter foundation. He took first-class honours in both Classical Moderations and the Final School of Literæ Humaniores. After graduation, a research studentship of the University and a scholarship from his college enabled him to devote himself to Mediterranean archæology. For two years he was an assistant on the staff of the Ashmolean Museum, and then in 1929 became director of the British School of Archæology at Athens. This post he filled with the greatest competence. Although in the term of his directorship no such major excavation as had attracted widespread attention under some of his predecessors occupied the activities of the members, the work of the school gained a decision and directness of purpose which made for a high level of efficiency and scientific precision in archæological training and research.

Payne's personal achievement was greatest in the field of archaic art. His "Necrocorinthia" (1929) and his subsequent excavation of the important site of Perachora, opposite Corinth, placed him in the front rank of archæologists as a pioneer and authoritative interpreter of Corinthian art and culture in the archaic period. His premature death has broken a career which held out every promise of great achievement.

WE regret to announce the following deaths:

Prof. Francis Cavers, formerly professor of biology in University College, Southampton, author of well-known text-books on elementary botany, on May 26.

Sir Archibald Denny, Bart., a well-known shipbuilder, and engineer, formerly president of the Institute of Marine Engineers and in 1918–27 chairman of the British Engineering Standards Association, on May 29, aged seventy-six years.

# News and Views

### The Right Hon. W. G. A. Ormsby-Gore

ARCHÆOLOGISTS, while congratulating Mr. Ormsby-Gore on his promotion in the ranks of His Majesty's Ministry, will feel that, in his appointment to succeed Mr. J. H. Thomas as Secretary of State for the Colonies, the Empire gains what archæology can ill afford to lose. No more suitable appointment to the Colonial Office could have been made; but as First Commissioner of Works Mr. Ormsby-Gore has been responsible for the protection of ancient monuments, and to that duty of his department has brought a knowledge of archæology and an enthusiasm for the surviving relics of the past in Britain that has been an inspiration to the members of his staff and an encouragement to all who are interested in the scientific investigation and the preservation of sites and structures of archæological or historic interest in Great Britain. Of the work—much of it of first-rate scientific importance—which has been carried out under the supervision and with the co-operation of the Office of Works during his tenure of office, it is unnecessary to speak here in detail; but by his personal activities, more especially in his efforts to secure the preservation of the unique character of Avebury and its surroundings, and in the initiation of the excellent series of guides to ancient monuments, of which he has already published two volumes, while a third is in an advanced stage of preparation, he has widely extended public interest in this class of evidence of the nation's cultural development. He leaves behind him a well-established tradition of official sympathy with, and co-operation in, the aims of archæological studies in Great Britain, which will not readily be allowed to die out.

MR. ORMSBY-GORE takes up his duties as Secretary of State for the Colonies at a moment when many problems, actual and potential, have to be faced. Not only has he the advantage of his experience in a previous administration, but also he brings to his task a personal knowledge of British Colonies and their problems such as has been possessed by no previous holder of the office. As Under-Secretary he travelled widely in all the more important of the Colonial possessions of the Empire and gained a first-hand knowledge of local conditions, more especially in Africa, which cannot fail to carry the weight of authority in the discussions of matters of momentous interest which are imminent. Mr. Ormsby-Gore's readiness in the past to appreciate the contribution of scientific studies in the solution of the practical problems of administrator, settler and native alike, affords an assurance that no resource will be overlooked in helping the Colonies in their efforts to recover from the effects of the economic crisis and the unrest to which it has given rise.

### Ancient Monuments in Southern England

THE second of Mr. Ormsby-Gore's guides to the ancient monuments, covering the area south of the Thames, includes the most impressive, as well as some of the most important, relics of the prehistoric period ("Illustrated Regional Guides to Ancient Monuments under the Ownership or Guardianship of His Majesty's Office of Works: Vol. 2, Southern England." London: H.M. Stationery Office, 1936. Pp. 86. 1*s*. net). Avebury, Stonehenge and Maiden Castle alone would serve to make this a volume of outstanding interest in the series; and in the subsequent periods its material is little less of note in its numerous aspects: to the important Roman fortresses of Richborough and Porchester must be added from the medieval period the castles of Dover and Carisbrook and the special attractions of the beautiful castle of Restormel in Cornwall and romantic Tintagel, while as an example of artistic achievement in a later age, the Queen's House at Greenwich by Inigo Jones is unrivalled in its way. Mr. Ormsby-Gore, following in general line the plan of his earlier volume, has provided for the prehistoric period a sketch of the cultures of the neolithic, bronze and iron ages, as well as of the period of Roman occupation, in which the monuments are called upon to illustrate and support the relation. Here the results of much recent research and discovery are digested and presented with a lucidity which cannot fail to hold and interest the least instructed visitor. The medieval period is treated under the two headings of Anglo-Saxon and Norman, and in this and the later sections history appears only to serve as a background. Mr. Ormsby-Gore has a gift of scholarship without pedantry. His second volume deserves the success which his first has already earned.

### Archæological Discoveries in India and the Far East

DISCOVERIES of great interest to archæologists and students of the religious cults of India have been made in recent excavations carried out by the Archæological Department of the Government of India at Raigir in the District of Patna, the ancient Rajagriha, in an area adjoining the Maniyar Math, a site investigated some thirty years ago by Sir John Marshall and the late Dr. Bloch. Their investigations brought to light a circular brick structure, which was dated by its stucco figures in bas-relief at about A.D. 500. The nature of this structure has been the subject of much speculation. According to a statement of Mr. J. F. Blakiston, director-general of archæology in India, reported in *The Times* of June 1, two earlier strata of buildings underlying the foundations of the circular structure have now been discovered, which carry the dating of the site back at least two or three centuries earlier. A large quantity of pottery and terra-cotta objects, which seems to

have been buried purposely, has been found in a brick enclosure to the east of the Math. Among this pottery one type has a series of spouts, in number from four to thirty-four and of various designs. Most of the vessels bear representations of snake-hoods. This fact is taken as a confirmation of the theory that the site was sacred to the worship of the Nagas or snake-goddesses. Pottery with multiple spouts is not known from other sites in India. The popular name of Maniyar Math, it is thought, may preserve a tradition of Mant Naga, the preserver and rain-giver of Rajagriha. If this indeed be so, it is suggested that these vessels with their multiple channels were the votive offerings of suppliants for rain, which were deposited in the compound of the shrine. Serpent worship at Raigir can be traced back to the third century B.C. and still persists as a popular cult. In the course of excavations carried out on behalf of the Raffles Museum, Singapore, on the Phinsoon Estate at Sungei Siput, Malacca, Prof. Van Stein Callenfels, the distinguished authority on the archæology of the Malayan archipelago, it is reported by Reuter, has discovered a number of human skeletons believed to date from about 2,500 B.C.

### The Approach to the Absolute Zero

THE Science Museum, South Kensington, has recently performed a most useful public service in arranging, in connexion with the Very Low Temperatures Exhibition, for a series of demonstrations and lectures by eminent authorities on recent scientific and technical developments. The series was concluded on Wednesday, May 27, by Prof. F. Simon, late of Berlin and Breslau and now of the Clarendon Laboratory, Oxford. Of the problems which can be investigated by experiment in the new temperature region below 1° Absolute, one of the most interesting is the specific heat of paramagnetic salts. In experiments carried out in conjunction with Kürti, Rollin and Lainé with the huge electromagnet of the Paris Academy of Sciences, it has been proved that the paramagnetic salts used become ferromagnetic at very low temperatures, showing Curie points of about 0·01° Absolute (see p. 961). The small helium liquefier used in the experiments was transported from Oxford. At the Science Museum, Prof. Simon succeeded in demonstrating a temperature of 0·12° Absolute, a noteworthy achievement, of which Prof. Simon and his co-workers, Mr. G. L. Pickard and Mr. A. H. Cooke, who were responsible for erecting the apparatus in the Science Museum and for the fact that the demonstration went off without a hitch, may well be proud. The magnet used in the experiment was lent by the Imperial College of Science and Technology; the hydrogen and helium pumps by Messrs. W. Edwards and Co.; the Cambridge Instrument Co., Ltd., provided a galvanometer. The limiting temperature region for this method lies between 0·01° and 0·001° Absolute. Further reduction of temperature will depend on the use of nuclear paramagnetism, starting at about 0·01° Absolute. Even to this method there will be a temperature limit, and the distance from the absolute zero, although very small when measured in degrees, is in reality an infinity. Although this unique series of lectures has now come to an end, the Exhibition of Very Low Temperatures will continue until the end of June. The Exhibition has so far attracted more than 140,000 visitors, and interest in it has not in any way diminished during the three months in which it has been on view.

### Maiden Voyage of the *Queen Mary*

BRITAIN'S newest and finest liner, the *Queen Mary*, left Southampton Docks on Wednesday, May 27, and entered New York Harbour about four and a half days later after successfully completing her maiden trans-Atlantic trip. Whatever may have been the results of this crossing from the point of view of marine navigation, a new standard was set up in radio communication by the most successful completion of a series of daily broadcasting programmes throughout the voyage. Never before has the whole world been able to follow so closely the daily happenings on board an ocean liner. The progress made in this application of the art of radio communication is illustrated by a note from a special correspondent of *The Times*, who recalled that he was one of the only two journalists on board the *Mauretania* on her maiden voyage to New York nearly thirty years ago: his instructions were to send not more than twelve words a day by wireless, and to post an article from New York. In contrast with this, the *Queen Mary* carried about 150 journalists, and some twenty broadcast commentators of various nationalities. During the voyage, more than sixteen hours actual broadcasting took place from the ship, while many hundreds of wireless messages of all kinds were sent to all parts of the world. To enable this work to be carried out, the normal wireless installation in the *Queen Mary* (which was referred to in NATURE of January 18 last) was supplemented by special equipment fitted by the British Broadcasting Corporation. More than twenty microphones were fitted in various parts of the ship so that the general life on board could be described direct from the scene of activity in the course of the daily broadcasting programme. Each evening, listeners to British stations were provided with an interesting commentary direct from the *Queen Mary*, while on one afternoon a special programme was arranged for schoolchildren.

THESE broadcasts were received in Great Britain via the ship-to-shore radio-telephone service of the Post Office; they were naturally relayed through the Empire system, and the high standard of performance attained is greatly to the credit of all those concerned with the arrangements. Similar programmes were arranged by the appropriate authorities for listeners in America, Denmark, France and Holland. The climax of this radio sound-picture was provided by the joint programme arranged by the B.B.C. and the National Broadcasting Company of America, as the *Queen Mary* proceeded up the

Hudson River to her pier in New York Harbour on the completion of her voyage on Monday, June 1. The thrilling scenes which accompanied the superb reception given by the hundreds of thousands of spectators were described by commentators at various vantage points, such as the quay front, a tug accompanying the giant liner, an aeroplane flying overhead and a special announcer located seventy stories up on the Radio City building. Since much of this programme had to be relayed over two or more radio links with the intermediate land-line connexions, the high average standard of the broadcasts illustrates the tremendous possibilities which result from the modern technique and organisation of this branch of communications engineering.

### Anniversary of Marconi's First Patent

FORTY years ago on June 2, Marconi filed the application for his first patent for a wireless invention. That patent—No. 12039 of 1896—described the use of Marconi's sensitive tube receiver, or coherer, connected to an earth and elevated aerial and the tuning of the transmitting and receiving circuits with each other. Since that time nearly 800 patents have either been granted to Marconi and the Marconi companies, or are pending, for the inventions and developments in wireless telegraphy and telephony and broadcasting. The first British ship was equipped with Marconi apparatus in 1901. To-day, more than 3,000 British ships carry Marconi wireless installations, and thousands of people owe their lives to its use. Wireless messages were exchanged between England and Canada in 1902, and a public service was opened in 1907. For direct transmission by the long-wave system the estimated power to the aerial amounted to something like 1,000 kilowatts, the stations were to cost more than £1,000,000 each, the wave-lengths were to be of the order of 18 miles, and the aerials were to be carried on towers about 800 feet high. These figures now seem fantastic. As the result of a series of tests between the experimental station at Poldhu and Marconi's yacht *Elettra*, in 1923 and 1924, the short-wave beam system was evolved which enabled the Marconi Company to make an offer to the Post Office to establish communication with the Dominions using a fiftieth of the power, involving a twentieth of the cost, and providing a speed of working at least three times as great as that which was possible with the earlier long-wave system of communication. Experiments in telephony by wireless were first carried out by the Marconi Company in 1906, and it is claimed that there are now 180 Marconi broadcasting stations in use in 32 countries. It is estimated that the wireless industry employs 50,000 workpeople in Great Britain, and that the British radio industry alone has a turnover of £30,000,000 per annum.

### *Zoo:* A New Periodical

THE Zoological Society of London has begun a venture which rounds off its benefactions to the nation. For well over a century its collections have amused and instructed the general public, it has spent vast sums upon the publication of scientific papers for the learned, and now in a popular monthly magazine it proposes to bring the interest of the zoo to those who cannot visit the enclosures, and generally to diffuse a knowledge of animals and their ways. Britain has lagged far behind the United States in the production of high-class popular magazines of science: we know nothing that can compare with *Natural History*, the journal of the American Museum of Natural History. But *Zoo*, in the quality of its text and in the interest and character of its illustrations, comes near to the American standard, and from the popular view it has gone one better, in leaving the stricter path of knowledge and introducing lighter stories of wild life. Many of the articles in the first number are by well-known scientific workers, and it is a pleasure to see that they possess the art of driving the pen so that the plain man can read.

### Cultivation of Cherries and Soft Fruits

THE healthy and expanding state of the fruit-growing industry in Great Britain is evident from the Royal Horticultural Society's report on the conference on cherries and soft fruits held in July last. This follows a similar report of the conference on apples and pears held in 1934. The chairman, Sir Daniel Hall, expressed the opinion in his opening address that no other branch of agriculture has profited so much from the findings of research, and this close connexion between the industry and the various research institutions is fully borne out by the papers read at the conference. These are contributed equally by officers of the research stations and commercial fruit growers, and display a close co-ordination between the two points of view. The subjects dealt with embrace every aspect of the soft fruit industry, particular attention being devoted to cultural problems and the control of pests and diseases, whilst extensive data are presented concerning manurial treatment and the effects of certain mineral deficiencies. A symposium on strawberry cultivation indicates the widespread interest in this fruit and the anxiety of both growers and research workers to deal with the numerous pests which have depleted the crop in recent years. Much information is given regarding the characteristics of varieties of cherries, raspberries and loganberries, and the qualities of fruit required for canning and bottling are also discussed. Copies of the report, price 6*s*., may be had from the Royal Horticultural Society, Vincent Square, S.W.1.

### Greenkeeping Research

EVERY question connected with turf production and maintenance comes under review at the St. Ives Research Station, Bingley, Yorks, and a perusal of the Report for 1935 published by the Board of Greenkeeping Research shows how rapidly both the experimental and advisory work have developed since the Station was founded in 1929. The bulk of the money required to finance the work is subscribed by British golf clubs through the national unions. Free postal

advice is supplied to subscribers on any green-keeping matter, and advisory visits are carried out at standard terms, the large number of requests for advice showing that the work of the Research Station is already widely appreciated. At the same time, it is inevitable that non-subscribing golf clubs are also reaping the benefits of the experience gained at the Station, and the Board urges all unions to consider whether the time has not come when every affiliated club should be required to make an annual minimum contribution to this work for the common good, at a fixed rate according to membership and size or number of their courses. A danger exists that if the present system of purely voluntary subscriptions is maintained, clubs which have supported the work liberally in the past may be unwilling to continue their subscriptions at the same rate, while other clubs obtain similar benefit for a smaller contribution or even contribute nothing at all.

### Oxford University Junior Scientific Club

THE triennial conversazione and exhibition meeting of the Oxford University Junior Scientific Club was held in the University Museum, Oxford, on May 23. An introductory lecture was given by Sir Edward Poulton, formerly Hope professor of zoology and one of the founders of the Club fifty-three years ago. A lecture, illustrated by a number of X-ray films, was given during the evening on "Cineradiology" by Dr. J. Russell Reynolds. A large number of exhibits of scientific interest were demonstrated by undergraduate members of the Club, and much research apparatus was on view. The exhibition was planned to provide both a summary of the progress of fundamental scientific research and a conspectus of the applications of research to modern life. The latter purpose was furthered by the generous assistance of many industrial undertakings, and of the Public Relations Department of the Post Office.

### Award of the Albert Medal to Lord Derby

THE Council of the Royal Society of Arts, with the approval of the president, H.R.H. The Duke of Connaught, has awarded the Albert Medal for 1936 to the Earl of Derby, "for the advancement of Commerce and Arts especially in Lancashire". The Albert Medal, instituted in 1863 as a memorial of H.R.H. the Prince Consort, who for eighteen years was president of the Royal Society of Arts, is awarded for "distinguished merit in promoting Arts, Manufactures and Commerce". The list of past recipients includes the names of many persons of the highest distinction, both in Great Britain and abroad; of the seventy-five awards which have been made, no less than forty-one have been to ordinary fellows and nine to foreign members of the Royal Society. Last year's Albert Medal was awarded to Sir Robert Hadfield.

### Linnean Society of London

AT the anniversary meeting of the Linnean Society of London held on May 28, the president, Dr. W. T. Calman, delivered his presidential address entitled "The Origin of Insects". The Linnean Gold Medal was presented to Prof. J. Stanley Gardiner. In making the presentation, the president referred to Prof. Gardiner's researches on the biology of corals, and the origin and development of coral reefs and islands, and also to his services to zoological exploration by means of the many important expeditions which owed their existence to his organising ability, and their success to his enthusiasm and leadership. The following were elected officers for the year 1936–37: *President*, Dr. W. T. Calman; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. John Ramsbottom (botany) and Dr. Stanley Kemp (zoology). The new members of the Council were Captain Cyril Diver, Mr. M. A. C. Hinton, Prof. R. C. McLean, Mr. Charles Oldham and Dr. Fred Stoker. The president announced that he had appointed the following vice-presidents: Mr. Francis Druce, Dr. John Hutchinson, Dr. Margery Knight and Lieut.-Colonel R. B. Seymour Sewell.

### International Congress of Genetics

THE Seventh International Congress of Genetics will be held in Moscow in the second half of August 1937. Preparations for the Congress have been begun by the Organisation Committee, under the presidency of A. I. Muralov, president of the Lenin Academy of Agricultural Sciences; other members of the Committee are N. I. Vavilov and V. L. Komarov (vice-presidents), S. G. Levit (general secretary), and N. P. Gorbunov, G. D. Karpechenko, B. A. Keller, N. K. Koltzoff, T. D. Lysenko, G. K. Meister, H. J. Muller, M. S. Navashin and A. S. Serebrovsky. All those working in the field of genetics are invited to present contributions. The titles and abstracts should reach the Organisation Committee before February 15, 1937. Detailed information concerning the programme, membership, exhibits, accommodation and transport are being prepared. Excursions to various parts of the U.S.S.R. will form part of the programme. Suggestions and applications for information should be sent to the General Secretary, Organisation Committee, Seventh International Congress of Genetics, B. Kaluzhskaya, 75, Moscow, U.S.S.R.

### Working-Class Family Budgets

IT was announced in the House of Commons on May 28 that the following committee has been appointed to advise the Minister of Labour as to the methods to be adopted in the collection of information, by means of family budgets, showing the approximate average weekly expenditure of working-class families on the items which should be taken into account in the construction of index numbers, designed to measure the percentage changes, from month to month, in the cost of maintaining a present-day standard of living: Mr. F. W. Leggett, Ministry of Labour (chairman); Mr. J. N. Beckett, Ministry of Health; Mr. F. J. Blakemore, past president of the National Chamber of Trade; Prof. A. L. Bowley, professor of statistics, University of London; Mr. H. Crow, Scottish Office; Mrs. W. Y. Darling; Mrs.

C. S. Ganley, of the Management Committee of the London Co-operative Society; Mr. J. Hallsworth, representing the Trades Union Congress General Council; Dr. J. M. Hamill, Ministry of Health; Mr. C. T. Houghton, Ministry of Agriculture and Fisheries; Mr. W. A. B. Iliff, Ministry of Labour, Northern Ireland; Mr. D. Caradog Jones, lecturer in social statistics, University of Liverpool, and director of the Social Survey of Merseyside; Mr. Kenelm Kerr, representing the National Confederation of Employers' Organizations; Mr. E. C. Ramsbottom, director of statistics, Ministry of Labour. The secretary to the committee is Mr. J. G. Cannell, Ministry of Labour, Queen Anne's Chambers, Broadway, Westminster, S.W.1.

### Announcements

THE National Physical Laboratory, Teddington, will be open (by invitation) for inspection of the work in progress, on Wednesday, July 1, at 3-6 p.m.

THE British Chemical Plant Exhibition 1936, which is being held at the Central Hall, Westminster, London, S.W.1, at the same time and in the same building as the international Chemical Engineering Congress of the World Power Conference on June 22-27, will be opened at 11 a.m. by the Right Hon. Ramsay Macdonald, in the Great Hall of the Central Hall on June 22. Invitations to the opening ceremony can be obtained on application to the Managing Committee, British Chemical Plant Exhibition, 166 Piccadilly, London, W.1.

PROF. HERMANN WEIGMANN has been elected an honorary member of the Vienna Society for Microbiology.

AN Institute for Racial Biology is to be erected at Copenhagen by grants from the Rockefeller Foundation and the Danish Government.

A GERMAN society for animal psychology has recently been founded in Berlin under the presidency of Prof. C. Kronacher, director of the Berlin Institute for Animal Breeding and the Genetics of Domestic Animals.

A SYMPOSIUM on "Excitation Phenomena" will be held in the Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor, New York, on June 23-25. Further information can be obtained from Dr. Eric Ponder, The Biological Laboratory, Cold Spring Harbor, Long Island, New York.

AN association of medical men and pharmacists who are men of letters has recently been founded in Paris under the presidency of Prof. H. Roger, formerly dean of the faculty of medicine, with Dr. Georges Duhamel, member of the Académie Française and editor of the *Mercure de France*, as vice-president. Further information can be obtained from the General Secretary, Prof. A. Sartory, 1a Place de l'Université, Strasbourg.

IT is announced that Sir J. J. Thomson, Master of Trinity College, Cambridge, is writing a book of reminiscences, which will be published early in the autumn by Messrs. Bell and Sons, Ltd.

ERRATUM. In NATURE of May 30, p. 900, paragraph headed "Cotton Industry in Northern Nigeria", for "English Cotton Growing Corporation" read "Empire Cotton Growing Corporation".

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An established assistant engineer in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, White-Hall Gardens, London, S.W.1 (June 9).

Temporary mechanical draughtsmen in connexion with research in air survey in the War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (June 10).

Two junior assistants (chemistry or physics) in the Chemical Defence Research Department (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (June 10).

A woman lecturer in mathematics and English in the Normal College, Bangor—The Principal (June 13).

A lecturer in botany in Armstrong College, Newcastle-upon-Tyne—The Registrar (June 13).

A lecturer in experimental physiology in University College, Cardiff—The Registrar (June 15).

A senior assistant lecturer in agricultural chemistry in the Edinburgh and East of Scotland College of Agriculture—The Secretary, 18 George Square, Edinburgh (June 17).

A technical officer and assistants (Grades II and III) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (June 19).

A half-time demonstrator in geology in Bedford College for Women, Regent's Park, N.W.1—The Secretary (June 20).

A lecturer in engineering (chiefly telegraphs and telephones) in the Cape Technical College, Capetown—J. A. Ewing and Co., Ltd., 73-74 Chiswell Street, London, E.C.1 (June 20).

A curator of Museum and Art Galleries in Paisley—Young, Martin, Martin and Sawers, 4 St. Mirren Street, Paisley (June 23).

A professor of physics in Canterbury University College, Christchurch, New Zealand—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1.

An assistant engineer in the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote *M*/4163).

A head of the Mechanical Engineering Department in the Royal Technical College, Salford—The Director of Education, Education Office, Salford.

An assistant engineer in the Public Works Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4199).

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 952.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Transmutation of Phosphorus, Sulphur, Chlorine and Potassium, and the Masses of Light Atoms

REFINED study of the artificial disintegration of light elements by $\alpha$-particle bombardment has revealed the important fact that the nuclear energy changes have discrete values presumably corresponding to quantised nuclear energy levels. These energy values are among the most definitely measurable properties of light nuclei and as such should be of importance to nuclear theory, but owing to the lack of experimental material no satisfactory explanation of these levels has yet been made.

We have observed the transmutation of sulphur, chlorine and potassium, all three of which emit protons under bombardment by thorium $C'$ $\alpha$-particles, and by measuring the ranges of the protons we have shown that each element emits three groups of protons corresponding to values of the nuclear energy change given in the accompanying table. The values are in millions of electron volts.

| $^{32}_{16}$S | $^{35}_{17}$Cl or $^{37}_{17}$Cl | $^{39}_{19}$K |
|---|---|---|
| Type $4n$ | Type $4n+3$ or $4n+5$ | Type $4n+3$ |
| −2·4 | +0·1 | −0·9 |
| −2·8 | −2·4 | −2·3 |
| −3·6 | −4·0 | −3·4 |

The values for sulphur agree with those given by Haxel[1]. The levels for $4n$-type nuclei appear to be more closely spaced than those for less simple types. The greater abundance of the $^{35}_{17}$Cl isotope renders it probable that this is the isotope responsible for the energy values found.

*Masses of Light Atoms.*

The most positive nuclear energy change in each transmutation is of considerable importance, since it measures the difference of mass on the two sides of the equation. Aston's recently announced values[2] enable use to be made of the $\alpha$-particle disintegration of $^{19}$F [3], $^{24}$Mg [1], $^{27}$Al [3,4], $^{28}$Si [1], in all of which protons are emitted, to determine the masses of the nuclei $^{22}$Ne, $^{24}$Mg, $^{30}$Si, $^{31}$P. By observation of the protons emitted by $^{32}$S and $^{35}$Cl when bombarded by $\alpha$-particles, we have been able to estimate the masses of $^{32}$S and of $^{38}$A, while the mass of $^{34}$S has been determined from experiments with $^{31}$P, which yielded results in agreement with Paton[6].

The second table gives the known isotopic masses for the elements neon to argon. In addition to the elements the masses of which have been determined by the above methods, we have given Aston's most recent values for the elements marked by asterisks, his 1927 value for $^{36}$A and Bainbridge's values[5] for $^{35}$Cl and $^{37}$Cl.

| Atom | Mass | Atom | Mass |
|---|---|---|---|
| $^{20}_{10}$Ne | 19·9986* | $^{31}_{15}$P | 30·9844 |
| $^{22}_{10}$Ne | 21·9985 | $^{32}_{16}$S | 31·9812 |
| $^{24}_{12}$Mg | 23·9938 | $^{34}_{16}$S | 33·9799 |
| $^{27}_{13}$Al | 26·9909* | $^{35}_{17}$Cl | 34·9796 |
| $^{28}_{14}$Si | 27·9860* | $^{36}_{18}$A | 35·976 |
| $^{29}_{14}$Si | 28·9864* | $^{37}_{17}$Cl | 36·9777 |
| $^{30}_{14}$Si | 29·9845 | $^{38}_{18}$A | 37·9753 |
| | | $^{40}_{18}$A | 39·9754* |

In a recent communication in NATURE, Oliphant[7] has given values for the masses of light atoms up to fluorine. He plots the departure of the mass from a whole number against the number of particles in the nucleus, obtaining a curve with well-defined minima at each multiple of four. In Fig. 1 we show his curve together with the extension permitted by the values given here, which are indicated as circles. It will be seen that the minima continue to appear in a less well-marked way until $^{40}$A is reached, where Aston's latest value indicates a heavier mass than would fit into a minimum. Since this nucleus contains a unit of four neutrons in place of an $\alpha$-particle unit, we can conclude that the observed extra stability found for multiples of four is to be ascribed to the existence of $\alpha$-particles in the nucleus and not merely to shells of four particles irrespective of charge.

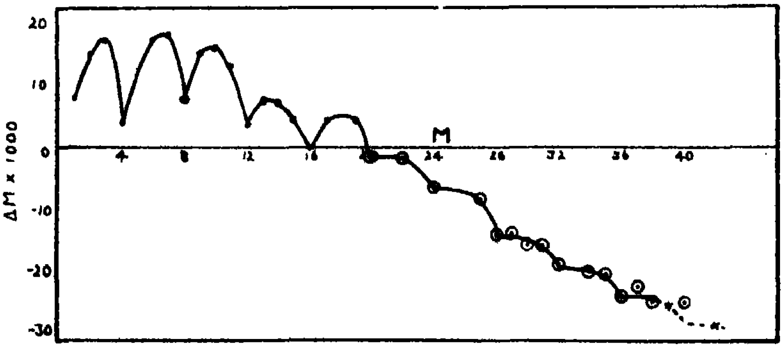


FIG. 1. Departure of mass from whole number plotted against nuclear mass number.

The fact that Aston's values for $^{27}$Al, $^{28}$Si and $^{36}$A and Bainbridge's values for $^{35}$Cl and $^{37}$Cl are used to determine other masses which show the expected regularity tends to confirm the accuracy of their measurements.

The transmutation of potassium permits derivation of the mass difference between $^{40}_{19}K$ and $^{40}_{20}Ca$. We have assumed that potassium has the mass given by the expected position (marked by the first cross in Fig. 1): the value for $^{40}_{20}Ca$ then lies as shown by the second cross.

E. POLLARD.
(Sterling Fellow.)
C. J. BRASEFIELD.
Sloane Physics Laboratory,
Yale University.
April 23.

[1] O. Haxel, *Phys. Z.*, **36**, 804 (1935).
[2] F. W. Aston, NATURE, **137**, 613 (1936).
[3] J. Chadwick and J. E. R. Constable, *Proc. Roy. Soc.*, A, **135**, 48 (1932).
[4] W. E. Duncanson and H. Miller, *Proc. Roy. Soc.*, A, **146**, 396 (1934).
[5] K. T. Bainbridge, *Phys. Rev.*, **43**, 378 (1933).
[6] R. F. Paton, *Z. Phys.*, **90**, 586 (1934).
[7] M. L. Oliphant, NATURE, **137**, 396 (1936).

## Variation of Cosmic Ray Intensity with Height in the Atmosphere

THE well-known curves of cosmic ray intensity obtained by Kolhörster, Regener and others show no trace of discontinuity, for they are mean values for intervals of many hundreds or even thousands of metres.

G. A. Suckstorff[1] made measurements every 100–130 m. in a slowly ascending balloon, using a Kolhörster apparatus. He found a discontinuous curve, the discontinuities being especially great in higher regions of the troposphere between 7,000 m. and 9,700 m., the deviations amounting to $\pm$ 30 *I*. It has been suggested by Suckstorff that the irregularities may be accounted for by the existence of radioactive substances in the higher layers of the atmosphere.

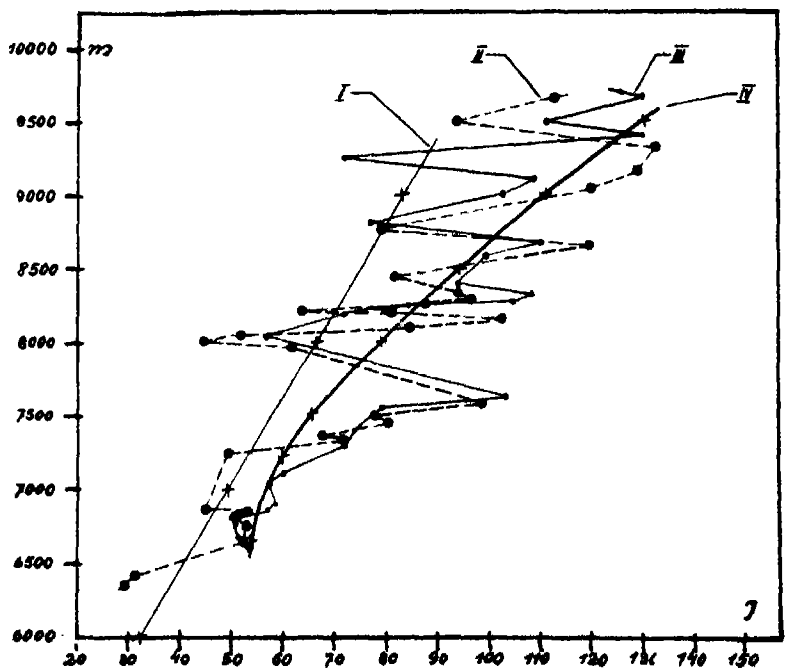


FIG. 1. Cosmic ray intensity. *I*: Kolhörster's measurements. II and III: curves obtained by Suckstorff. IV: curves obtained by Ziemecki and Narkiewicz-Jodko (only a few points are marked).

In order to examine the question more closely, we undertook similar observations. On March 29, an ascent was made in a free balloon (*Warszawa II*, 2,200 cu. m.) which reached the height of 10,800 m. During the slow ascent of the balloon between 6,600 m. and 10,000 m. measurements of ionisation were made. Our results give a smooth curve, the deviations from it in no case exceeding 5 per cent, and being in general less than 2 per cent (Fig. 1).

We used an ionisation chamber of approximately 1 litre capacity, filled with argon at a pressure of 15 atm., and connected with a Lindemann electrometer. The sensitivity of the electrometer was approximately 0·01 volt per division. Thus, individual measurements did not last more than 40 sec. The batteries were kept at constant temperature by means of a constant temperature jacket.

We think the discontinuities observed by G. A. Suckstorff were due to the irregularity of the movement of the electrometer thread, the Kolhörster apparatus not being sensitive enough for measurements of short duration.

We hope to be able to repeat our observations. Experimental details will be published in *Bulletin Acad. Polon.* We take this opportunity of expressing our thanks to the Department of Aeronautics of the Ministry of War, and especially to Capt. Z. Burzyński, who piloted the balloon.

ST. ZIEMECKI.
K. NARKIEWICZ-JODKO.
High School of Agriculture,
Warsaw. April 4.

[1] G. A. Suckstorff, *Phys. Z.*, **35**, 368 (1934).

## The ¹X-level of the Hydrogen Molecule

As a result of the analysis of the near infra-red spectra of $H_2$, HD and $D_2$, some new facts have been discovered concerning the so-called $^1X$-level of the hydrogen molecule which remove many of the uncertainties and difficulties in the interpretation of this level.

The analysis of the $^1X \rightarrow 2p\,^1\Sigma$ systems of HD and $D_2$ showed quite clearly that the vibrational quantum numbers of the $^1X$-level given by Richardson[1] (but considered doubtful by him) must be raised by one.

The $0 \rightarrow 0$ bands of all three molecules were then discovered in the region near 11,200 A. The rest of the band system is distributed chiefly through the near infra-red. For $H_2$ my analysis agrees with that of Richardson for the principal lines, but there are several deviations. The $1 \rightarrow 0$ band for which Richardson gives only two lines is a strong, well-developed and fairly regular band.

The $V = 0$ level of $^1X$ is quite regular without any trace of perturbations or decoupling. The effective moments of inertia are 0·871, 1·156 and 1·725 $\times$ $10^{-40}$ for $H_2$, HD and $D_2$ respectively, and the effective internuclear distance is 1·019 $\times$ $10^{-8}$ cm. The $V = 1$ level shows a very faint perturbation, and the higher levels are strongly perturbed. The perturbations are of the same nature

as if they were caused by the interaction with a $^1\Sigma$-level.

The only two theoretical states with low enough energy and the right symmetry with which the empirical $^1X$-level can be identified are $1s\sigma\ 2s\sigma\ ^1\Sigma_g$ and $(2p\sigma)^2\ ^1\Sigma_g$. I identified originally[2] the $^1X$-level with $1s\sigma\ 2s\sigma\ ^1\Sigma$, and this explanation has been adopted by Richardson[3], who has emphasised the difficulty due to the fact that for a $1s\sigma 2s\sigma \Sigma$ state we should expect neither perturbations nor decoupling. On account of these and other difficulties, Weizel[4] believes the $^1X$ state to be $(2p\sigma)^2\ ^1\Sigma$, but his arguments are largely invalidated by the new facts, which make the objections to the first explanation disappear.

The moment of inertia is considerably different from the value calculated previously from the higher vibrational states, and agrees very well with what should be expected for $1s\sigma 2s\sigma ^1\Sigma$. As the $V = 0$ level is completely regular, the observed irregularities in the other vibrational levels cannot be due to the ordinary $\Lambda$-decoupling, but they must be true perturbations. Perturbations of just this kind can arise from interaction with the $(2p\sigma)^2\ ^1\Sigma$ level. On account of the Pauli exclusion principle, this level does not exist in the triplet system, which explains the fact that the $1s\sigma 2s\sigma ^3\Sigma$ level shows no traces of perturbations. I have not yet succeeded in finding the $(2p\sigma)^2\ ^1\Sigma$ level empirically, but calculations are being made here to determine theoretically its properties.

G. H. DIEKE.

Johns Hopkins University,
Baltimore, Md.

[1] O. W. Richardson, "Molecular Hydrogen and its Spectrum".
[2] G. H. Dieke, *Z. Phys.*, **55**, 447 (1929).
[3] O. W. Richardson, NATURE, **135**, 99 (1935).
[4] W. Weizel, *Z. Phys.*, **65**, 456 (1930).

## Raman Effect and Free Rotation

THE molecule of ethylene halide, $XH_2C–CH_2X$, has an axis C–C, around which the two $CH_2X$ groups are capable of rotation, but not all the rotational states are equally probable. The most stable state corresponds to the *trans* configuration which has a centre of symmetry and no dipole moment. The mean dipole moment of the molecule increases with the decreasing number of molecules in the *trans* state[1]. We have made intensity measurements of the Raman lines together with the dipole moments[2] and have shown that the intensity ratio $I(\omega_1)/I(\omega_2)$ of the two strong Raman lines $\omega_1$ and $\omega_2$ decreases as the number of molecules in the *trans* state increases ($\omega_1 = 653, \omega_2 = 752$ for $C_2H_4Cl_2$ and $\omega_1 = 551$, $\omega_2 = 656$ for $C_2H_4Br_2$). The intensity measurement was also carried out for the solid state and at lower temperatures, and it was observed that the line $\omega_1$ disappeared completely, while the line $\omega_2$ remained very strong, that is, $I(\omega_1)/I(\omega_2) = 0$.

We have shown by the use of the appropriate values of the force constant that $\omega_1$ corresponds to the antisymmetric and $\omega_2$ to the symmetric vibrations in the *trans* state[3], consequently $\omega_1$ is not permitted in the Raman effect, so long as the molecule is in the *trans* state. If, therefore, we consider that the characteristic frequency of the molecule is not appreciably different from state to state in the neighbourhood of the *trans* state, the intensity change observed above will at once be explicable from the selection rule. We must then consider that in the solid state and at lower temperatures almost all the molecules are in the *trans* state.

According to the assumption due to Kohlrausch[4], our observation should be explained as follows :— in the solid state these molecules are in the *trans* state, while in the liquid state or in solutions some are in the *cis* and others in the *trans* states.

The experiments are being continued. We have to thank Prof. M. Katayama for his kind advice.

SAN-ICHIRO MIZUSHIMA.
YONEZO MORINO.
SHICHIRO NOZIRI.

Chemical Institute,
Faculty of Science,
Imperial University,
Tokyo.
March 20.

[1] Mizushima and Higasi, *Proc. Imp. Acad. Japan*, **8**, 482 (1932).
[2] Mizushima, Morino and Higasi, *Phys. Z.*, **35**, 905 (1934). *Sci. Pap. I.P.C.R. Tokyo*, **26**, 1 (1934).
[3] Mizushima and Morino, *Phys. Z.*, **36**, 600 (1935). *Sci. Pap. I.P.C.R. Tokyo*, **26**, 1 (1934).
[4] Kohlrausch, *Z. phys. Chem.*, B, **18**, 61 (1932), ibid., **29**, 274 (1935).

## Magnetron Oscillations

IN seeking to explain how electrical oscillations are maintained by a single anode magnetron, I have found a mathematical theory of which this is a short account. It is hoped that a fuller one will appear in the *Quarterly Journal of Mathematics*.

The theory is worked out for a filament of small radius $a$ (taken as zero in part of the theory) and a co-axial cylindrical sheath of radius $b$ (called the plate), each of length $l$ much greater than $b$. The magnetic field is $H$ and the emission $I$. I have shown, in a paper sent to the *Quarterly Journal*, that a saturated current $I$ per cm. is turned back at a radius $15{,}400\ I^{1/2}/H^{3/2}$, from which it follows (what has no doubt been fully realised by experimenters) that the current in ordinary magnetron experiments is much below saturation. We can therefore ignore space charge, and we assume further that $b$ is much smaller than the wave-length of the oscillations. Let $-e$ be the charge and $m$ the mass of an electron, $\omega = He/mc$. The electrons move out and back in circles in a total time $2\pi/\omega$, and together form a cloud extending to a certain distance $k$ from the filament. If a small periodic potential of frequency $\nu$ (containing in general a constant term and harmonics) is added to a former steady potential, the cloud oscillates, and the distance to which it extends at time $t$ is easily found. If $k$ is nearly equal to $b$, the cloud may either (1) always reach the plate, (2) never reach it, (3) reach it during part of the period.

In case (3), which we consider first, the inward stream is interrupted. What is the current at any time ? Consider first a thin layer of electricity, of charge $-s$ per unit length, distant $r$ from the filament at time $t$, and let $-f$ and $p$ be the charges per unit length on filament and plate, $V$ the scalar electromagnetic potential of the plate above the filament. Then the current from plate to filament is $l\,df/c\,dt$, where $f - p + s = 0$ and $V/c = 2f \log (r/a) + 2(f + s) \log (b/r)$. Thus the current is $i = KdV/dt + 2cKs\,d \log r/dt$, where $K$ is the capacity of the cylinders. The second term may be called the convection current, though electrical influence plays a part too. It flows during the whole time that the layer is between the electrodes. In the magnetron, the charge leaving the filament between times $t_0$ and $t_0 + dt_0$ is $-cIdt_0$. If $I$ is small, $r$ can be taken

from the steady motion, and the element of convection current is $-(2c^2KI\,\partial\log r/l\,\partial t_0)dt_0$. Thus if the electrons between the plates, beginning with those which left first, extend at time $t$ from $r_1$ to $r_2$, $r_3$ to $r_4$, and so on, the convection current is

$$(2c^2KI/l)\,(\log r_1 - \log r_2 + \log r_3 - \log r_4 + \;.\;\;.\;\;.\;).$$

We have now a complete mathematical basis for solving any particular problem. I shall consider the simplest, in which all the electrons (somewhat unphysically) are emitted normally with the same finite velocity, so that those which return are caught on the filament. Then the convection current is independent of $t$ in cases (1) and (2), and no oscillations can be maintained. If $\nu = \frac{1}{2}\omega$, and if the cloud of electrons grazes the plate once in every period, the mode of maintenance is fairly obvious. The boundary lags a quarter period behind the applied potential. A small gap in the return stream then moves back, and if the time of grazing is a small fraction of the period, though large compared with the time an electron is in the strong field near the filament, a convection current nearly equal to $I$ flows for a time $2f\pi/\nu$ after a further quarter period has elapsed. The convection current is thus opposite to the potential at the time being.

Many problems can be proposed and solved. I have worked out the theory of a magnetron in a condenser circuit with $\nu = \frac{1}{2}\omega$, the high potential being connected through a large choke. If the resistance $R$ of the circuit is so small that $RI$ can be neglected, the oscillations are nearly sinoidal (having harmonics of a lower order than the fundamental) and the frequency is given approximately by Kelvin's formula $LKC\nu^2 = K + C$. The amplitude of oscillating potential on the plate is

$$2fILC/RK\,(K + C).$$

When a triode maintains slow oscillations, a certain minimum reaction is needed, and the amplitude cannot be determined by a linear theory. There is nothing like this with a magnetron, but the amplitude is determinate, proportional directly to $I$ and inversely to $R$.

F. B. PIDDUCK.

Corpus Christi College,
Oxford.
April 8.

## Combined Ascorbic Acid in Food-stuffs

THERE has lately been some discussion about the state in which ascorbic acid is present in natural food materials. Ahmad[1], and McHenry and Graham[2] observed that several fresh food-stuffs like cabbage, cauliflower, carrots, etc., give a higher ascorbic acid value on being cooked or boiled with water, as estimated by titration with the indophenol reagent. They conclude that at least part of the vitamin is present in the fresh food-stuffs in the combined state, from which the free vitamin is released on boiling with water. Van Eekelen[3], on the other hand, working with the potato, considers that the increase in the vitamin content on boiling is only apparent and not real, being due to the inactivation of ascorbic acid oxidase, which is normally present in these food-stuffs, by heat. We have carried out the following experiments in this connexion, which, we believe, demonstrate almost conclusively that the increase of the vitamin C value of certain food-stuffs on boiling cannot be accounted for on the oxidase theory, and that part of the vitamin in the natural food-stuffs is present in the combined state. All the estimations were carried out titrimetrically.

(1) Cabbage, when extracted with absolute alcohol in presence of anhydrous sodium sulphate, yields an extract, which, when heated for 4 minutes on a boiling water bath in an atmosphere of nitrogen, invariably gives an increased vitamin C value. Frequently the increase varies between 50 and 100 per cent. The alcoholic extract, on being heated at 36° for 10 minutes in an atmosphere of nitrogen, also shows a very considerable increase in vitamin C value, very often of the order of 50 per cent.

(2) Cabbage, on extraction with ether in the presence of anhydrous sodium sulphate, provides an extract, which, as such, gives practically no vitamin C value. On heating the air-dried ethereal extract in an aqueous medium on a boiling water bath for 4 minutes in an atmosphere of nitrogen, a considerable vitamin C value is obtained.

(3) Bel (*Aegle marmelos*), a common Indian fruit, gives alcoholic and ethereal extracts which behave similarly to those of cabbage, though the order of increase is not so great in this case.

(4) The increase in the vitamin C value of the aqueous extract of cabbage on boiling is shown also if the titration is carried out after mercuric acetate or formaldehyde treatment in order to remove interfering substances.

It is very unlikely that absolute alcohol and ether would extract the ascorbic acid oxidase from cabbage and 'bel', which might come out in an aqueous extract. Moreover, the oxidase, if extracted by alcohol, would scarcely be destroyed by 10 minutes' exposure to 36°, a treatment which produces a very considerable rise in the ascorbic acid value. Ether can apparently be made use of in separating the free ascorbic acid from the combined ascorbic acid in cabbage, the former being insoluble and the latter soluble in this solvent. It has been found that the aqueous extract of cabbage, on being made 0·2 per cent acid with hydrochloric acid and allowed to stand for an hour, also gives a considerably increased vitamin C value, which would indicate that gastric juice would split the combined ascorbic acid of food-stuffs fairly effectively. Ripe and unripe mangoes have not yielded an increased vitamin C value under the above treatments. It would seem, therefore, that not all food-stuffs contain the vitamin in the combined state.

B. C. GUHA.
J. C. PAL.

Indian Institute for Medical Research,
Calcutta.
April 27.

[1] Ahmad, NATURE, 136, 797 (1935).
[2] McHenry and Graham, NATURE, 135, 871 (1935).
[3] Van Eekelen, NATURE, 136, 144 (1935).

## Petroleum-soluble Fluorescent Constituents of Leaves

WHEN petroleum ether extracts of dried leaf material are passed through Tswett adsorption columns composed of magnesia and siliceous earth, the leaf pigments are adsorbed, and colourless solution percolates through the column[1]. The very first portions of the percolate contain colourless hydrocarbons recoverable in crystalline form. Other

colourless substances are slightly adsorbed on the magnesia, and may be recovered from subsequent portions of the percolate. The weakly adsorbed, colourless leaf constituents absorb ultra-violet light, in contrast to the non-adsorbed hydrocarbons which are transparent. Of particular interest, however, are two products which are strongly fluorescent in ultra-violet light. These substances form fluorescent bands or zones on the adsorption columns just below the α-carotene band. The light emitted by the fluorescent bands appears white to the eye, but, in the hand spectroscope, it ranges from the long green to the short red wave-lengths. Crystals, obtained after elution of the fluorescent bands with petroleum ether and ethanol, were strongly fluorescent, being comparable to anthracene and carbazole in this respect. Upon exposure to air the crystals slowly lost their fluorescent properties. Each fluorescent substance, dissolved in cyclohexane, exhibited strong absorption of ultra-violet light, particularly at shorter wave-lengths, but no maxima or minima were observed.

Saponification of leaf extracts before adsorption did not reduce the yield of the fluorescent constituents or alter their relative positions upon the adsorption columns. This and the occurrence of the fluorescent bands below the carotene bands on the adsorption columns indicate that the fluorescent substances do not contain ester, carboxyl or hydroxyl groups or their analogues.

By means of adsorption columns, one or both of the fluorescent substances have been isolated from the leaves of all the plants examined, from many other plant products and from etiolated maize and barley seedlings. Small quantities of other fluorescent substances (not yet isolated in crystalline form) give rise to fluorescent bands above the β-carotene band upon the adsorption column. These reactive materials, by their fluorescence and concomitant activation, may affect many physiological processes, such as photosynthesis, pigment formation, cell elongation and light tropisms, and may account for some of the fluorescence of etiolated seedlings and of other pigment-free parts of plants.

The adsorbent magnesia, originally prepared for the separation of carotenes[1] (Micron Brand Magnesium Oxide No. 2641, manufactured by the California Chemical Company, Newark, California), is itself highly fluorescent and phosphorescent. These properties of the magnesia are not altered by different solvents or by adsorbed substances, such as alcohols, and may prevent the detection of weakly fluorescent substances which are adsorbed upon the Tswett columns. Siliceous earth, used as an aid to filtration in the magnesia columns (Hyflo Super Cel, F.A.501, manufactured by Johns-Manville), contained small quantities of organic substances which were removed by washing with petroleum ether and ethanol. Siliceous earth may therefore be a source of contamination when used as an aid to filtration or when introduced into reaction media.

I am indebted to Dr. W. G. Leighton for many determinations of absorption coefficients in the ultra-violet and to members of this Division for helpful suggestions.

HAROLD H. STRAIN.

Carnegie Institution of Washington,
Division of Plant Biology,
Stanford University, California.
April 6.

[1] H. H. Strain, *J. Biol. Chem.*, **105**, 523 (1934); ibid., **111**, 85 (1935).

## The Earliest Published Figures (1613–1758) of the Oblong or Truncate-tailed Ocean Sunfish, *Ranzania truncata*

IN the course of my researches in the history of ichthyology, I have found the earliest published figure of the truncate-tailed ocean sunfish, *Ranzania*. This figure seems unknown to ichthyologists generally, and hence it should be reproduced where it will become widely known.

The ocean sunfishes, family Molidæ, or millstone-shaped fishes (Latin *mola* a mill), are so called because their short well-nigh tailless bodies give them a rather rotund form. The commonest sunfish is the round-tailed form, *Mola mola*. This fish, being found in the Mediterranean Sea, was known to the ancients, and was referred to by the classical writers (Aristotle, Aelian, Oppian, Pliny and others). It was first figured and described by Guillaume Rondelet in 1554. The pointed-tailed fish, *Masturus lanceolatus*, was discovered at Mauritius in 1835 by Elizé Liénard, and was described by him in 1840 and figured in 1841.

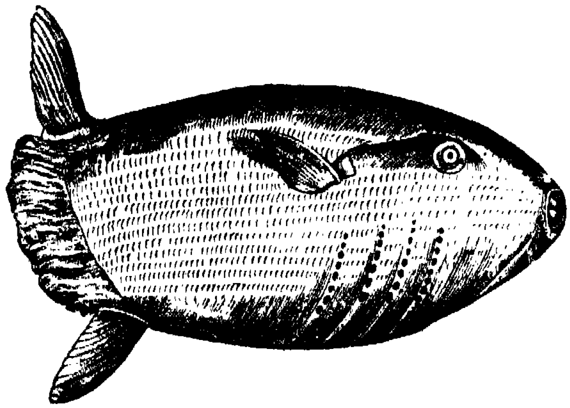

FIG. 1. The "Mola peregrina" of Aldrovandi, 1613. The earliest published figure of the oblong or truncate-tailed ocean sunfish.

The third form, *Ranzania truncata*, was first figured (but not described) by one of the earliest and in many ways the greatest of the Italian natural historians—Ulisse Aldrovandi. On page 413 of his great book, "De Piscibus Libri V" (Bononiae, 1613), is found the interesting woodcut reproduced herewith (Fig. 1), the first published representation of the fish in question. This Aldrovandi calls "Mola peregrina". This adjectival designation may mean—from foreign parts, exotic, wandering; or it may mean—merely unusual, out of the ordinary. In his text, Aldrovandi makes no reference to either figure or fish. However, we know that to Aldrovandi's museum in Bologna came curious animals from many foreign countries, and this fish might be classed as foreign but for two things. First it is found in the Mediterranean—not so plentifully, however, as *Mola*—and in the second place the figure seems to have been drawn from a fresh specimen.

The modern name of Aldrovandi's "Mola peregrina" is *Ranzania truncata*. The generic name was given in honour of Ranzani, another Italian writer on the Molidæ—about 226 years later; "truncata" of course means truncate, out off, and this Aldrovandi's "Mola peregrina" surely was.

In the figure, the fish is shown to be oblong, the hinder end is truncate obliquely downward and forward. The position and form of mouth, eye, gill-

opening, and of the fins paired and unpaired—all are those of *Ranzania*. The three oblique stripes with spots are colours characteristic of the fresh animal, and lead to the conclusion that the drawing was made shortly after the capture of the fish.

Aldrovandi's figure was reproduced in a brass plate engraving by John Jonston in 1649[1] without any credit being given to Aldrovandi. From this time on, the figure seems—strangely enough—to have been lost sight of by modern ichthyologists. The only ones who, so far as I know, have referred to it are Steenstrup and Lütken in their great review paper on the Molidæ[2]; and they give it but a line and do not even reproduce Aldrovandi's figure, though they copy a number of early figures of *Mola*, including that of Aldrovandi, which is found on the page facing his "Mola peregrina".

The next figure of *Ranzania* following Jonston's is, so far as I know, one by Janus Plancus, dated 1746[3] and interestingly enough published in Aldrovandi's home city 130 years later. No source is given but presumably the fish came from the Adriatic. This figure is a brass plate engraving fairly well done, with a highly conventionalised transparent tail-fin, and a poorly drawn mouth. Attempt has been made to show the coloured streaks shown in Aldrovandi's figure. With all its imperfections, this figure surely portrays *Ranzania*.

The next old figure of this fish known to me is in William Borlase's "Natural History of Cornwall" (London, 1758). His Fig. vii, Pl. xxvi, is a crude but recognisable woodcut of the oblong sunfish. This drawing must also have been made from a fresh fish, since it shows the colour markings on the forward lower part of the body. Confirmatory is Borlase's description of the colour, particularly of the "streaks". It was a small fish—26·25 inches long by his scale. Borlase calls it "Ostracion oblongus", and states that it was captured at Penzance in May 1743.

From this time (1758) on, the fish was not infrequently captured (especially on the shores of western Europe), became fairly well known and was figured by many authors. However, to Aldrovandi in 1613 belongs the credit for the first published figure of the truncate-tailed ocean sunfish, *Ranzania truncata*.

E. W. GUDGER.

American Museum of Natural History,
New York.

[1] "Historia de Piscibus, . . .", Francofurti, Fig. 1, pl. ix.

[2] Bidrag til Kunskab om Klump-eller Maanefiskene (Molidae). *K. Danske Vidensk. Selsk. Skrifter*, 6, ix, 54 (1898).

[3] "De Mola pesci". *De Bonon. Sci. Art. Instit. Acad. Comment. Bononiae*, 2, pars ii, 297–308 (1746).

## Orientation of *Chirocephalus* and *Daphnia*

*Chirocephalus:* The best explanation of the peculiar inverted swimming position of many Anostraca and Notostraca is that advanced by Lowndes[1] who, when directing attention to the respiratory function of the appendages, suggested that the attitude is concerned with respiration, for in this position the appendages can be brought into contact with the uppermost and best aerated layer of water.

Experiments were made to see what factors govern this attitude and how it is maintained. *Chirocephalus* swimming in a tank shows a moderately strong positive phototactic reaction when light is switched on; this, of course, is a shock reaction. When light falls from above, the normal inverted position is maintained; if, however, illumination is from below, the first reaction is to swim towards the light, the second to re-orientate so that the ventral groove is still directed towards the light. This falls into line with the work of McGinnis[2] on *Branchippus*, and Seifert[3] on *Lepidurus* and *Apus* (= *Triops*). The latter believes the compound eyes to play no part in this orientation, and that it is due to the median eye.

*Chirocephalus*, when illuminated from below, cannot maintain this attitude with the ventral groove directed downwards unless some part of the body, perhaps only the tips of the caudal rami, is touching the bottom, otherwise it automatically turns on its back with the ventral groove upwards.

Narcotised *Chirocephalus* when placed in water in any position rapidly attain the normal attitude and sink thus. It may, therefore, be assumed that orientation is normally maintained by the shape of the body and calls for no muscular exertion. It would seem unlikely that there are statocysts or other organs of orientation.

The experiments on light, however, show that there is some association between it and orientation. Cannon[4] has pointed out that *Chirocephalus* sometimes feeds dorsal side uppermost on the bottom. Lowndes[1] has referred to this and states significantly that he believes it to happen at night; for it is then that the creatures would be free from the stimulus of light, and it is very likely that in response to other stimuli they would descend to the bottom to feed.

The inverted position is taken on early in life. The nauplius, which swims almost entirely by means of the second antennæ, nearly always swims vertically in the water, but on those occasions on which it swims horizontally the ventral surface is directed upwards; this becomes more pronounced in the metanauplius. The completely horizontal attitude is adopted when the first group of thoracic appendages begins to assist in swimming. The gradual transference of the swimming function from the antennæ to the thoracic appendages is interesting, for the antennæ beat as they do in the nauplius while the thoracic appendages are beating in metachronial rhythm.

*Daphnia:* Orientation to gravity is of vital importance to planktonic creatures for another reason. During darkness, most planktonic animals maintain themselves at a fairly constant level in the water. Thus a creature sinking passively, does so in such an attitude that when it starts swimming it will automatically move upwards and so counteract the previous sinking; otherwise it might sink and swim out of the planktonic region altogether. In many Crustacea, statocysts are present to subserve this function, and in Brachyurous larvæ the spines are thought to be concerned with this function (see Foxon[5]).

Experiments were performed to see how this orientation is maintained in *Daphnia magna* and *D. pulex*. Narcotised *Daphnia* were found to sink dorsal side downwards unless the second antennæ were stretched out in front of the head in the position in which the effective stroke of the swimming movements is begun. In this attitude they sank with the head uppermost, and if they could have started swimming they would have moved upwards. *Daphnia* swimming freely without light stimulus will be seen alternately to sink in this attitude and to swim up.

It appears that in this case orientation to gravity is due to a combination of bodily shape and posture. That it is not due to the activities of other appendages can be shown by removing the second antennæ, when they are unable to retain the normal orientation.

G. E. H. FOXON.

Department of Zoology,
University of Glasgow.

[1] Lowndes, *Proc. Zool. Soc. Lond.*, 1093 (1933).
[2] McGinnis, *J. Exp. Zool.*, 10, 227 (1911).
[3] Seifert, *Z. vergleich. Physiol.*, 11, 386 (1930).
[4] Cannon, *Phil. Trans.*, 222, 267 (1933). *Proc. Roy. Soc.*, B, 117, 455 (1935).
[5] Foxon, *J. Mar. Biol. Assoc.*, 19, 829 (1934).

## Occurrence of Pollen of *Carpinus* (Hornbeam) in Irish Peat

ALTHOUGH peat samples from Continental bogs frequently yield hornbeam pollen, there appear to be so far only two records of it from British peat bogs; that from the Blanchland peat of Northumberland investigated by Raistrick and Blackburn[1], and that from the Orkneys[2].

There is no published record from Ireland. It might therefore be of interest to workers who are or have been engaged on pollen analysis in Ireland to know that pollen grains, probably of hornbeam, have been found in Irish peat. Two specimens were obtained at a depth of 1·5 m. from highly humified *Sphagnum* peat in the Burrough Bog, Timahoe, Co. Kildare, in the course of preliminary investigations. They were provided with four pores and measured 30–32μ in diameter (Fig. 1).

FIG. 1. Photomicrograph of hornbeam pollen grain from Irish peat. Actual size, 31·2 μ. × about 850.

It is generally agreed that the hornbeam is not native in Ireland, and that in Britain it is native only in the south-east. So far as could be ascertained, the earliest record of the hornbeam in Ireland as an introduced tree is that found in Threlkeld's flora published in 1727, where he gives it the Irish name *Crann Sleauhain*.

C. J. LA TOUCHE.

Botany Department,
University College,
Dublin.
April 26.

[1] *Proc. Univ. Durham Phil. Soc.*, 8, Pt. 4.
[2] Erdtman, *J. Linn. Soc. Bot.*, 46, 480 (1924).

## Age of Ferro-Manganese Concretions

THE determinations of the radioactivity of a series of ferro-manganese concretions of the seas and lakes of the U.S.S.R.[1] (especially of the Kara Sea[2] and lakes of Karelia[3]) have brought out certain facts (the surface layer is more active than the central part, the want or insignificant contents of Th X–MsTh) which make possible the determination of the age of the concretions by the content of radium in its different layers.

The first specimen examined was one of the largest concretions from the Kara Sea (Station 74, expedition on the *Sedov* in 1934. Lat. 76° 2′ N.; long. 86° 13′ E., depth, 58 m.).

The concretion is of fairly regular, disk-like form with a pebble in the centre (size, 80–90 mm.; thickness, 11–12 mm.; weight, 117·74 gm.; size of pebble, 12–30 mm.; weight, 12·77 gm.). The concretion was divided into three shells, each of which consisted of a group of thin concentric layers.

The results of the chemical analysis (made by V. A. Yegorov) have shown the constancy of the chemical composition of the separate shells

Determinations of radium gave the following results:

| Shell | Average width | Weight | Ra content (per cent × $10^{-10}$) | Per cent |
|---|---|---|---|---|
| I | 8 mm. | 31·15 gm. | 19·3 | 100·0 |
| II | 10 ,, | 47·15 ,, | 12·1 | 62·7 |
| III | 14 ,, | 26·31 ,, | 3·1 | 16·1 |

Such a decrease of radium content from the outer (I) to the inner (III) shell must be regarded as the results of its disintegration.

Taking the contents of radium in shell (I) as the earliest we obtain the following time-values:

From shell I to II . . 1,100 years
,, ,, I to III . . 4,200 ,,

The age of the concretion examined would appear to be 5,300–5,500 years.

The results obtained show that in the development of the concretion there were periods (as for example between shells II and III) during which the growth of the concretion stopped or was greatly slowed down. Possibly, too, there are periods in which there was a partial destruction of surface layers.

The second specimen examined was a concretion from Lake Uksche, Karelia (size, 30–40 mm.; thickness, 18–20 mm.; weight, 10·10 gm.). The concretion was divided into two parts. Determinations of radium gave the following results:

| | Average width | Weight | Ra content (per cent × $10^{-10}$) | Per cent |
|---|---|---|---|---|
| I (outer shell) | 5 mm. | 5·21 gm. | 13·5 | 100·0 |
| II (central part) | 24 ,, | 4·64 gm. | 8·6 | 63·7 |

From the data obtained we obtain the following time-values from the outer shell to the central part, 1,030 years, and the age of the concretion about 2,000 years.

Investigations show that in several cases it is possible also to determine the rate of formation of

different kinds of deposits (for example, contemporary marine deposits, sediments of springs, etc.) according to the change in the content of radium or elements of the thorium group in separate layers of these deposits.

L. M. KURBATOV.

Arctic Institute,
Leningrad.

[1] L. M. Kurbatov, NATURE, 136, 871, Nov. 30, 1935.
[2] L. M. Kurbatov, "Radioactivity of Ferro-Manganese Formations of Kara Sea" (in preparation).
[3] L. M. Kurbatov, ibid.

## Normal Erosion as a Factor in Soil Profile Development

AMONG the factors concerned in the development of soil profiles, erosion has, until recently, received comparatively little attention. I venture to direct attention to two possible examples of the influence of normal erosion, as distinct from catastrophic erosion, on the course of profile development.

(1) Studies in North Wales and elsewhere have shown the occurrence of soil profiles which may be described as 'truncated', that is, profiles in which the surface soil resembles the sub-surface or $B$-horizon material of developed podsol profiles in possessing a sesquioxidic type of clay fraction. I was formerly disposed to attribute their origin to removal of the siliceous $A$-horizon by erosion consequent on deforestation and cultivation[1]. Further consideration of the problem, however, suggests that it is not necessary to postulate catastrophic erosion to account for such profiles.

Whilst such erosion may have occurred in past centuries, and is known to occur in certain regions, for example, in the United States, at the present day, it seems possible that normal erosion could account for the observed facts. Such slow erosion will affect principally the immediate surface soil, which, under the humid conditions of western Britain, tends to be more siliceous in character than the underlying soil. The steady removal of material more siliceous than the body of the soil profile, operating over centuries, must result in a relative enrichment of the residual material in sesquioxides.

The actual profile will represent a balance between the podsolising process, resulting in the development of an $A$-horizon impoverished in sesquioxides, and the process whereby this relatively siliceous horizon is removed. Truncated soils of a sesquioxidic character are found most commonly in regions of strong relief. In Wales, they are characteristic of the foothills. They are less common at high altitudes, where, it may be presumed, podsolisation keeps pace with erosion.

The suggestion may be hazarded that a similar process has operated in the formation of the sesquioxidic soils of humid tropical regions.

(2) A second example of the possible effect of normal erosion may be seen in soil profiles developed in clay formations such as the Gault and the Keuper Marl. Almost invariably, the surface soil shows a more sandy texture than the subsoil. This has been ascribed to the presence of sandy wash of external origin or, alternatively, to mechanical eluviation within the profile. In the latter case, a horizon of maximum clay accumulation would be expected, whereas normally there is a steady increase in the clay content down the profile.

While either or both of the above two causes may produce the observed differences in texture between surface and subsoil, I would suggest that normal erosion, involving lateral removal of the finer fractions, is generally a sufficient explanation of the observed facts. Such removal might take place along the surface of the soil itself or along the surface of a water table. In either case, the result would be to produce a surface horizon relatively richer in the coarser fractions than the parent material. The effect would be more pronounced under arable or partially arable conditions than under a permanent closed cover of vegetation.

G. W. ROBINSON.

University College of North Wales,
Bangor. May 12.

[1] G. W. Robinson, *J. Agric. Sci.*, 20, 618 (1930).

## Cohesion of Alkali Metals

IN two recent papers[1] I have developed a statistical method for calculating the cohesion of the alkali metals. The density of the metal electrons in the lattice has been supposed to be constant. As cohesion energies, the following have been taken into account: the electrostatic energy of the metal electrons with respect to the simply charged ions, the exchange energy of the metal electrons and the correlation energy of the metal electrons with antiparallel spins as calculated according to Prof. E. Wigner and Dr. F. Seitz[2]. As causing repulsive forces, the electrostatic energy, the zero-point energy of the metal electrons and the energy resulting from their penetration into the electron clouds of the ions have been taken into account. The repulsive forces between the ions are also taken into consideration.

The method applied to the calculation of the heat of evaporation of potassium, rubidium and cæsium gives the following results[3]:

| | | K | Rb | Cs |
|---|---|---|---|---|
| Heat of evaporation | Calc. | 21 kcal./mol. | 18 kcal./mol. | 18 kcal./mol. |
| | Observed | 26·5 kcal./mol. | 25·0 kcal./mol. | 24·0 kcal./mol. |

Calculated values of the lattice energy and of the lattice constant are also in good agreement with experimental values. All these results were obtained without assuming empirical parameters.

PAUL GOMBÁS.

Institute of Theoretical Physics,
University of Budapest.
April 3.

[1] P. Gombás, *Z. Phys.*, 94, 473 (1935); 95, 687 (1935).
[2] E. Wigner and F. Seitz, *Phys. Rev.*, (2), 46, 509 (1934). E. Wigner, *Phys. Rev.*, (2), 46, 1002 (1934).
[3] A detailed paper will appear in the *Zeitschrift für Physik*.

## Stresses in a Rotating Disk

THE stresses set up in a rotating disk appear first to have been considered by Maxwell[1], and the solution adopted by many engineering text-books[2] shows that an axial hole, however small, halves the strength of the disk. This result, which is repugnant to physical intuition, does not appear to have been tested experimentally. During the design of an ultra-centrifuge[3] to be used for separating isotopes, we had to investigate the effect of a small axial hole on the bursting speed of the rotor, and it is interesting to compare our results with the above theory.

With disks of 8 cm. diameter and 1 cm. thickness, made from 'magnuminium', a magnesium alloy of high specific tensile strength, the breaking speed of 1,500 rev./sec. was unchanged by a 1 mm. axial hole. With rotors shaped so as to have nearly uniform stresses throughout, the presence of a hole lowered the breaking speed about 10 per cent, or the strength 20 per cent. Unluckily for our purpose, a radial hole reduces the strength to less than half. In these experiments peripheral speeds as high as 700 metres per second were recorded.

H. C. POLLOCK.
C. H. COLLIE.

Clarendon Laboratory,
Oxford.
May 14.

[1] J. C. Maxwell, "Collected Papers".

[2] A. Stodola, "Dampf und Gasturbinen", Sixth Edit. Timoshenko and Lessels, "Applied Elasticity". J. Prescott, "Applied Elasticity".

[3] J. W. Beams and E. G. Pickels, *Rev. of Sci. Inst.* (U.S.A.), Oct. 1935.

## Origin of Levirate in Assam

RECENT investigation *in situ* among the different tribes of Assam has led me to think that the hitherto accepted theories on the origin of levirate seem to be untenable in this area. This institution varies so widely from area to area, and the theories propounded so far being based on materials from different countries, that a separate explanation for Assam is needed.

Of the two types of levirate, the junior and the senior, the former is by far the more widely prevalent in Assam, though among some of the Old Kukis groups, for example, Aimols, Mantaks, Anals, etc., both types are still in vogue. But as the tribes are coming in contact with the people of superior culture who dislike this custom, it is losing its force. For example, the Wainoms having long been influenced by the Meitheis, who have discarded this practice, do not look upon this type of union with favour. Amongst them the senior levirate is absolutely forbidden. The junior levirate also, though found in exceptional cases, is not looked upon with favour. The Chiru Kukis, who are coming in contact with the Meitheis, have already deviated from some of their social customs and also forbid senior levirate; though junior levirate is still to be found amongst them. The other branches of the Old Kukis, who are far away from civilisation and have very rarely come in contact with peoples of superior culture, do not embrace these tenets and they still practise both types of levirate.

The avoidance of senior levirate in this area has sometimes resulted from a dislike for polygyny amongst the people. The elder brother having generally married before the younger, he cannot take the younger brother's widow without having a plurality of wives. The younger brother who is not married, however, weds the deceased brother's wife. For this reason this type of union is more common. In this area, economic factors also play a very important role.

The high bride-price and service in the house of the future father-in-law for several years put a great hardship on the people, and they always try to get round this custom. In some tribes, we find that the rich men are trying to substitute payment for service. Poor men cannot have recourse to this alternative; but by accepting the hand of the deceased brother's widow, they can avoid this service, and so amongst them it is more common. Moreover, the property of the deceased brother comes into the possession of the man marrying the widow, who in a sense has been earned by payment and service. Thus the combination of both economic and social factors tends to the widespread prevalence of this institution in Assam.

J. K. BOSE.

Department of Anthropology,
University, Calcutta.
March 18.

## Simple Relations between Vibrational Frequencies of Isotopic Molecules

THE following relations may be useful in discussions of the isotopic effect in Raman spectra. Let $\nu_i'$ and $\nu_i''$ be corresponding frequencies of the isotopic molecules, $m_a'$ and $m_a''$ the masses of the isotopic atoms and $A_{ab}$ the constants of the vibrational potential energy; then

$$(2\pi)^2 \sum_i (\nu_i'^2 - \nu_i''^2) = \sum_a \left(\frac{1}{m_a'} - \frac{1}{m_a''}\right) A_{aa};$$

$$(2\pi)^4 \sum_i (\nu_i'^4 - \nu_i''^4) = \sum_{ab} \left(\frac{1}{m_a'\, m_b'} - \frac{1}{m_a''\, m_b''}\right) A_{ab}.$$

Similar equations hold for the 6th, 8th and following powers of the frequencies. The equations may be applied to each symmetry class separately, if symmetry co-ordinates are suitably chosen.

Applications of these equations, especially with regard to the problem of benzene, will be discussed elsewhere.

H. TOMPA.

50 Bryn Road,
Swansea.
April 25.

## Karl Pearson

MR. G. UDNY YULE's interesting obituary of Karl Pearson (NATURE, May 23, p. 856) does not offer "the meed of some melodious tear" to his efforts for the creation of a great University of London. "K. P." collected his ephemeral contributions on this question in a small book, "The New University of London" (Fisher Unwin, 1892). Appendix C (p. 130) deals exhaustively with the contributions of Sir Thistleton Dyer and Sir Ray Lankester to NATURE of May and June 1891; but "K. P." himself does not appear to have used this journal for his polemics. Unlike Huxley, he was as regards the colleges an 'absorptionist', his somewhat naïve idea being that absorption would prevent domination. For the vigour of its dialectic, this little book is a delight.

Although at variance on a question of fundamental policy, "K. P." acknowledged—and this is characteristic of the man—"that Huxley's leadership did at any rate a great deal to unite the London teachers and raise their ideal of a true university, while at the same time helping to repress the self-interests of many persons and institutions which had been before very much to the front" ("Life and Letters of Thomas Henry Huxley", vol. 2, p. 314).

T. LL. HUMBERSTONE.

15 Gower Street, W.C.1.
May 25.

## Points from Foregoing Letters

EXPERIMENTALLY determined values of the nuclear energy change for the transmutation of sulphur, chlorine and potassium are given by Dr. E. Pollard and C. J. Brasefield. These suggest that the energy levels are closer in nuclei of the type $4n$ than in more complex nuclei. The masses are derived for the majority of nuclei from neon to argon. Plotting departure of mass from whole number against nuclear mass number (Oliphant), these show indications of extra stability at each repetition of four units until $^{40}A$ is reached, which is exceptional, indicating that the stability is due to $\alpha$-particles and not to units of four irrespective of charge.

Dr. St. Ziemecki and Dr. K. Narkiewicz-Jodko have taken measurements of cosmic ray intensity at individual points between 6,600 m. and 10,000 m. in a free balloon, and find that the results fall on a smooth curve, contrary to the results obtained by G. A. Suckstorff during similar observations.

New observations on the infra red spectra of molecular hydrogen of the light ($H_2$), heavy ($D_2$) and mixed (HD) type are reported by Prof. G. H. Dieke. The author calculates that the effective moments of inertia are 0·871, 1·156 and $1 \cdot 725 \times 10^{-40}$ for $H_2$, HD and $D_2$ respectively, and the effective internuclear distance is $1 \cdot 019 \times 10^{-8}$ cm. The observed spectrum lines are attributed to the so-called $^1X$ level of the hydrogen molecule, and the author discusses how far this empirically deduced 'level' can be identified with one or another of the theoretically deduced 'states' inferred from the current theory of the structure of the hydrogen molecule.

From the intensity of certain lines in the Raman spectrum of the light scattered by organic substances like ethylene dichloride, the molecules of which may have two different configurations known as *cis* and *trans*, S. Mizushima, Y. Morino and S. Noziri deduce that in the solid the molecules are in the *trans* state; in the liquid form or in solutions some are in the *cis* and others in the *trans* state.

A mathematical theory of the maintenance of electrical oscillations by a single anode magnetron is put forward by Dr. F. B. Pidduck. The stream of electrons must be interrupted, and oscillations can then be maintained by any emission, however small, provided the resistance of the circuit is small.

Prof. B. C. Guha and J. C. Pal find that extracts of cabbage and of bel (*Aegle marmelos*) obtained with absolute alcohol and ether give a considerably increased vitamin C value on being heated. This increase is ascribed to the splitting of bound ascorbic acid, and not merely to an apparent increase caused by the destruction of the appropriate oxidase by heat.

The isolation of two fluorescent substances from leaves, barley seedlings, etc., by means of adsorption on magnesia in a percolator (Tswett column) is described by Dr. H. H. Strain. The author considers that by their fluorescence these substances may affect many physiological processes, such as photosynthesis, pigment formation, cell elongation and sensitivity to light, and may account for the fluorescence of etiolated seedlings and of other pigment-free parts of plants.

A figure of the truncate-tailed ocean sunfish, *Ranzania truncata*, published by Ulisse Aldrovandi in 1613, is submitted by Dr. E. W. Gudger, as being the earliest known drawing of that species. Dr. Gudger gives a review of other early references and drawings of ocean sunfishes.

G. E. H. Foxon points out that orientation to gravity is of vital importance to both the fairy shrimp (*Chirocephalus*) and the water flea (*Daphnia*), although for quite different reasons. From experiments it is concluded that in *Chirocephalus* orientation is a direct result of bodily form, and that in *Daphnia* it is due to a combination of shape and posture; in neither case do special organs of orientation appear to be involved.

A photomicrograph of a pollen grain of hornbeam (*Carpinus*) found at a depth of 1·5 m. in highly humified peat in the Burrough Bog, Timahoe, Co. Kildare, Ireland, is submitted by C. J. La Touche. It is of interest in view of the general assumption that the hornbeam has been introduced only recently in Ireland.

From the variation in the radium content in successive layers of ferro-manganese concretions, the time of deposition is calculated by L. M. Kurbatov. For one specimen, from the Kara Sea, this comes out at 5,300–5,500 years, and for another specimen from Lake Uksche, Karelia, at about 2,000 years.

The ash-coloured soils of forest-land have a 'profile' or structure consisting of an upper leached ('podsolised') layer ($A$) and a lower coloured layer ($B$) enriched by iron oxides and humus. Prof. G. W. Robinson suggests that in the case of 'truncated' soils, where the upper siliceous ($A$) layer is lacking, this has not necessarily been removed by rapid ('catastrophic') erosion following upon deforestation and cultivation, but that it may have been brought about by normal erosion involving the lateral removal of the finer fractions of the soil constituents.

P. Gombás calculates the heat of evaporation of potassium, rubidium and cæsium metals from data referring to the energy of the metal electrons and the simply charged ions; he finds good agreement with the experimentally determined values.

Experimental results on the effect of the presence of a small hole on the strength of a rotating disk are described by H. C. Pollock and C. H. Collie. They find that, contrary to theoretical deductions, which state that an axial hole however small should halve the strength of the disk, a small axial hole reduces only slightly the breaking point; a radial hole was found to reduce the strength to less than half.

The practice of 'levirate' (according to which a widow must marry a brother of the deceased husband) by various tribes in Assam is discussed by J. K. Bose. He concludes that this custom originated in Assam by a combination of social and economic factors different from those to which it has been ascribed in other countries.

Two formulæ giving the relation between the vibrational frequencies that affect the Raman spectra and the masses of isotopic molecules (molecules of equal mass) are given by H. Tompa. These formulæ, the author indicates, may be useful in connexion with the problem of the structure of benzene.

# Research Items

### Cephalic Types among the Seminole Indians

IN the summer of 1932, Dr. Wilton Marion Krogman and others with him secured an anthropometric record of a number of full and mixed blooded Seminole Indians of Oklahoma. The Seminole is apt to be an extremely mixed type. Linguistically they are referred to the Muskogean stock, belonging specifically to the northern division, which embodies Upper Creek, Lower Creek and Seminole. In physical character, the Seminole incorporates diverse elements, Indian, Negro and white. From 1702 onwards the Creek gradually absorbed Floridan tribes, among whom were the Oconees, who formed the essential nucleus of the Seminoles. The Oklahoma Seminoles appear to have mixed more freely with both white and Negro than the Florida Seminoles have done. There also have been in the Oklahoma Seminoles occasional crosses with Comanches, Kiowa, Caddo, Pawnee, Shawnee and other neighbouring tribes. The data examined by Dr. Krogman (*Z. Rassenkunde*, **3**, 2; 1936) are derived from the cephalic dimensions and indices of 109 full-blooded Seminoles and 41 Seminole-Creek mixed-bloods. The head is found to be of moderate length, full-blood, male, 191·9 mm.; mixed, male, 192·1 mm.; broad, full-blood, male, 132·7 mm.; mixed, male, 133·6 mm. The cephalic type of both the full-blood and the mixed groups tends to sub-brachycephaly and moderate hypsicephaly. The forehead is wide. On the basis of the frequency distribution of cephalic indices and the calculation of the coefficient of variation, it is concluded that the full-blooded Seminoles are relatively homogeneous. It is thought possible that the long- and high-headedness may have been introduced by whites, the most frequent intermarriage being with whites of Scottish descent.

### Anahæmin B.D.H.

THE success of liver therapy in the treatment of pernicious anæmia has naturally led to many attempts to isolate the active principle. The basis of most subsequent work was the investigation of Cohn, Minot and their co-workers, who isolated a fraction from liver which was both active when given by mouth and could also be administered by injection. More recently, Dakin and West (*J. Biol. Chem.*, **109**, 489; 1935) obtained a polypeptide from liver which they showed to be curative in pernicious anæmia when injected subcutaneously in quite small doses. The British Drug Houses, Ltd., London, N.1, has prepared this polypeptide, to which the name 'Anahæmin' has been given; its hæmatopoietic activity has been demonstrated, in clinical trials arranged by the Medical Research Council, by Ungley, Davidson and Wayne (*Lancet*, Feb. 15, p. 349): reference to this work was made in the Council's Report for 1934–35. Anahæmin yields on hydrolysis the amino-acids lysine, arginine, glycine, leucine, hydroxyprotine and aspartic acid, together with glucosamine. One injection of 2 c.c. of a solution containing 200 mgm. of anahæmin produced an immediate reticulocyte response, followed by a striking increase in the number of red blood corpuscles, which was maintained for a period of more than thirty days. Further, there was considerable subjective improvement, and in the cases which manifested signs of degeneration of the cord, there was noticed a distinct amelioration of the symptoms.

### Parasites of *Munida*

THE species of *Munida* and their Rhizocephalian parasites in northern European waters form the subject of an exhaustive investigation by Brinkmann (Bergens Museum Skrifter No. 18, 1926). It is divided into three parts, the hosts, the parasites, and the hosts with their parasites; the last section is subdivided into two portions, (1) the general relationships between the two, and (2) the effects of the parasite upon the tissues of the host. Three species of *Munida* are recognised, namely, *M. bamffia*, a form rarely found below 100 m.; *M. sarsi* (the *M. rugosa* of Sars but not of Fabricius) generally found between 100 m. and 300 m.; and *M. tenuimana* which has 250–300 m. as its upper limit. Three species of parasites are also recognised, namely, *Lernæodiscus ingolfi* found on all species of *Munida* but principally on *M. sarsi*; *Triangularis munidæ* similarly found on all but mostly on *M. sarsi*, and *T. boshmai* found equally on two species but only once on *M. bamffia* in many thousands of specimens. The infection takes place at a moult of the host. In a number of double infections it was found that both parasites were of the same size, and so presumably infected the host at the same time. A smaller group, however, showed infections at different moults, and from this it is evident, despite what was previously thought, that infection does not ensure immunity against subsequent infections. The effects of parasitism on the host are fully discussed, and the author finds that Geoffrey Smith's theory does not explain the phenomena in *Munida*. The work is well illustrated.

### A New Enteropneust

KAPELUS (*Ann. Nat. Mus.*, **8**; 1936) gives a detailed account of a new enteropneust, *Saccoglossus inhacensis* which was collected by Mortensen and by van der Horst in Lourenço Marques. It presents two features of interest. First, the nervous tissue is very well developed and an epidermal nerve layer is present in proboscis, proboscis stalk, collar and a thinner layer in the body region. In the collar the central nervous system is hollow for part of its course, and its neural crests are still in direct connexion with the epidermis without being separated from it by the limiting membrane. This shows clearly its derivation from the ectoderm. The body region also has a dorsal and ventral cord, and the position of the former is marked externally. Secondly, for the genus, this species possesses a large number of gill slits, up to 82 pairs. The last six pairs are reduced to mere circular canals, without tongue bars, placing the alimentary canal in direct communication with the exterior.

### Metabolism of Stored Fruit

THE inhibition of ripening in fruit and of germination in seeds and potatoes has recently been discussed by M. Copisarow (*J. Pom. and Hort. Sci.*, **14**, 1, 9; 1936). In experiments with potatoes he has obtained inhibition of sprouting and suppression of fungal decay by spraying with a 1 per cent solution of maleic acid in amyl acetate. Normal development occurred on discontinuing the treatment. Similar results were obtained when potatoes were treated with an amyl acetate emulsion of the ether extract residue from unripe apples, whilst the extract residue from mature apples gave slight sprouting and over-ripe apples more vigorous sprouting. Ripening of Newtown Pippin and Jonathan apples, pears and green bananas was also suppressed by the maleic acid treatment. In all cases, an aqueous solution of maleic acid was found to be unstable in its inhibiting effect compared with the amyl acetate solution. Attention is directed to the fact that the decline in naturally occurring inhibition is accompanied by evolution of the accelerator (ethylene), and it is suggested that maleic acid may probably be identical with the natural inhibitor, the 'blastokolin', which, according to Kockemann, has the properties of an unsaturated acid. On the basis of the chemical and physiological similarity between maleic acid and the naturally occurring inhibitor and the constitutional link between ethylene, maleic acid and the acid-fruit constituents, it seems not improbable that maleic acid acts as inhibitor and is degraded to ethylene with the onset of ripening. Certain practical applications to fruit storage are discussed, and it is suggested that paraffin oil wrappers containing maleic acid might be effectively used.

### Ink Disease of *Iris reticulata*

THE outer bulb scales of *Iris reticulata* are sometimes attacked by a fungus which causes the appearance of inky black patches. *Mystrosporium adustum* is the organism concerned, and as its horticultural significance is not fully understood, Mr. D. E. Green has carried out several experiments upon the incidence and control of the malady (*J. Roy. Hort. Soc.*, **61**, Pt. 4, 167–175, April 1936). Artificially inoculated bulbs rotted very quickly, but naturally infected organs flowered, and showed relatively little effect of the disease, except a decrease in the number of bulbs over a period of years. Rotting was always more rapid in unsterilised, than in sterilised, soil, thus indicating that the actual destruction of tissues is brought about by secondary organisms. The experiments on control seem to show that it is improbable that any simple treatment can eradicate the disease, and the most that can be done at present is to reduce the spread of the fungus by annual lifting and removal of diseased bulbils.

### West African Timbers

UNDER the auspices of the Department of Scientific and Industrial Research, two pamphlets have been issued by the Forest Products Research Laboratory, Princes Risborough (*For. Prod. Res. Records*, Nos. 6 and 7. London: H.M. Stationery Office, 1935), dealing with the properties of an African mahogany and mansonia respectively. Generally speaking, the investigations on the two timbers are discussed under distribution, description of tree and of the timber, seasoning and mechanical properties, durability, working qualities, uses and supplies. The home of both species is in the African forests. The African mahogany (*Khaya anthotheca*) occurs in mixed evergreen and deciduous forest, ranging from the Ivory Coast, through the Gold Coast, Nigeria, French Cameroons and Angola to Uganda in the east. The specimen of the tree submitted to tests at Princes Risborough came from Uganda. The supplies in the past have come mainly from the Ivory Coast. From the tests undertaken, it is considered at Princes Risborough that this mahogany is suitable for the purposes to which other African mahoganies are applied. It is said to be superior to *Khaya ivorensis* in strength, but only equal in stiffness, whilst under transverse loads the timber is slightly inferior to the Central American mahogany, *Swietenia macrophylla*. Valuable data on the African mahoganies have also been obtained by French investigators (Bois Coloniaux; Plaquette documentaire éditée sous les auspices du Comité National des Bois Coloniaux. Paris: Musée des Colonies, 1935). The Mansonia (*Mansonia altissima*), so far as present records go, occurs in the deciduous forests of west tropical Africa from the Ivory Coast through the Gold Coast, Dahomey to Nigeria. From the research work undertaken by one of the sylviculturists in Nigeria with this species, it would appear to be possibly more abundant than has hitherto been surmised; and it seems under suitable conditions to regenerate with comparative ease. The timber has a similarity to black walnut in appearance and strength properties. It is therefore considered that it should be fit for use for practically all purposes for which black walnut has previously been employed, including the manufacture of propellers for aircraft, an important and increasing economic demand.

### Halleförs Dolerite Dyke, Sweden

AN important contribution to the petrology of basaltic intrusions is made by T. Krokström in a study of the great Halleförs dyke of Middle Sweden (*Bull. Geol. Inst. Upsala*, **26**, 115–263; 1936). The dyke is about 40 km. long, has an average width of 1 km., and trends east and west. The marginal type is mainly ophitic olivine-dolerite, associated with a coarser variety which locally shows a glassy development of its interstitial material. The central parts of the eastern half of the dyke display an apparently continuous variation from coarse, even-grained dolerite to markedly porphyritic types with a very fine-grained groundmass. The latter types, and even, in part, the dolerites, have locally been subjected to albitisation which is referred to late magmatic processes. A few small dykes of adamellitic affinities intersect the marginal dolerite and are interpreted as consanguineous with the rocks of the central suite. Certain granophyre veins, however, found near the margin, are thought to have been generated by transfusion of the gneissic country rocks. In the western part of the dyke a few exposures of helsinkitic rocks and epidotic breccia occur. These are interpreted as results of pneumatolytic action combined with a certain amount of mechanical deformation. The age of the dyke cannot be irrefutably established, but it is shown that there is no reasonable objection to the general opinion that it is post-Jotnian. Comparison is made with the Breven dyke. It is found that both dykes are consanguineous, but that the present section exposed through the Breven dyke is a deeper one as compared with that through the Halleförs dyke.

### Destructive Earthquakes of 1935

IN the latest issue of the *Matériaux pour l'Étude des Calamités* (No. 36, 160–163; 1935), M. C. Bois gives a list of the destructive earthquakes that occurred during the latter half of the year 1935 (see NATURE, 136, 639; 1935). The total number of such earthquakes is 24, making 40 for the whole year, in some of which, however, the damage caused was extremely slight. During the first half of the year, there were four earthquakes of the highest degree (III) of Milne's scale for destructive earthquakes, and during the latter half only one, namely, the Turkestan earthquake of October 8, during which 105 lives were lost. If the total number of earthquakes for the year is somewhat less than usual, their destructiveness, as measured by the loss of human lives (about 35,000), is above the average of about 28,000 given in NATURE of April 11, p. 605.

### Surface Temperatures in Sliding Friction

F. P. BOWDEN and K. E. W. Ridler (*Proc. Roy. Soc.*, A, May 1) have made experiments in which two metals in sliding contact were used as the elements of a thermocouple, and estimates of the surface temperature were made. This temperature may be quite high (above 1,000° for constantan on mild steel), though the mass of the metal remains cool. A simple calculation of the rate of production of heat and its transfer by conduction shows that high local temperatures are to be expected, particularly as only a fraction of the surface is actually in contact. The temperature rises with the load and the speed of sliding but reaches a constant value corresponding to the melting point of one of the metals, when the latter is relatively fusible (for example, gallium, Wood's metal, lead). The experiments were repeated with the surfaces lubricated under 'boundary' conditions—that is, covered with an adsorbed film of lubricant. Here also high temperatures were observed, and it is suggested that the high temperature is an important factor in the breakdown of the boundary film. There is evidence from other work that the boundary film is continually broken down and regenerated during sliding.

### New Methods in Mass Spectroscopy

A. J. DEMPSTER has recently described (*Proc. Amer. Phil. Soc.*, 75, 8) a new mass-spectrograph with which he has obtained several new and important results (see NATURE, 135, 542; 135, 993; 136, 65; 136, 180). The source of positive ions is a vacuum spark energised by a Tesla circuit. This arrangement gives singly and multiply charged ions of all the electrode metals tried, including palladium, platinum, gold and uranium, which have proved recalcitrant in other arrangements. The arrangement for analysing the rays consists of an electrostatic field between curved plates, followed by a magnetic field, and it gives focusing of ions of constant $m/e$ even if both their initial directions and initial velocities are spread over limited ranges. This double focusing property represents an advance on the arrangements of Aston and of Bainbridge.

### Locating Underground Rock by Sound Waves

IN *Roads and Streets* of April, a simple method developed by the U.S. Bureau of Public Roads for locating the distance of rock beneath the ground surface is described, and is said to be giving excellent results. The method has been previously used extensively when prospecting for oil at considerable depths, but in these cases elaborate and costly apparatus has been used. The device now employed is a highly sensitive seismograph, and by its use the time and expense required for drilling to find out how deep the rock lies is saved. Accurate results are obtained by measuring the speed with which an impulse from the explosion of a buried blasting cap travels through the earth. The impulse travels through soil at a speed of 1,000–6,000 ft. per sec. but through rock it travels at a rate of 16,000–20,000 ft. per sec. When the cap is exploded, a record is made for the time measurement. Special detectors are placed on the ground at different distances from the explosion and pick up the impulse as it comes through the ground. The detectors are electrically connected with the time-recording device. When a detector is close to the explosion, one impulse coming through the soil is received. At greater distances an impulse coming through the soil is received and also another which has travelled through soil to rock, through rock and finally from the rock to the surface, arriving at the detector a fraction of a second later. At still greater distances the impulse moving through soil and rock arrives ahead of the impulse moving more slowly through the soil alone. From the data thus obtained, it is possible to calculate how far the impulse went downward through the soil before it encountered rock.

### Lightning Discharges and Atmospherics

AN investigation has been made by H. Norinder, of the Institute of High-Tension Research, University of Uppsala, on the relation between lightning discharges and atmospherics in radio-receiving. The investigation lasted over two years, and a very large number of atmospherics was recorded. In a paper to the *Journal of the Franklin Institute* of May, he discusses in detail the observations and the results he has obtained. The author's method of studying atmospherics is to use horizontal aerials in connexion with resistances and cathode ray oscillographs. The atmospherics were observed in mobile field stations. By varying their position it could easily be found out whether any of the effects were produced by high-tension transmission lines. By connecting loud speakers to the aerial as well as the cathode ray oscillographs, a simultaneous record was obtained of the noise and the associated disturbances. A very clear distinction was obtained between the atmospherics of short duration ('clicks') and the atmospherics of long duration ('grinders'). The 'clicks', in the author's opinion, are due to local actions inside the thunderstorm clouds, such as short sparks which are not easy to detect by visual observations. They can be seen when an aeroplane traverses local showers of rain, snow or hail. The 'grinders' are quite distinct from the clicks both in their general aspect and the way they vary. Good reasons are given for believing that 'grinders' are caused by distant lightning discharges. It is shown that the field of an electric discharge will, after a short passage in the atmosphere, be transformed into superimposed components having different periodic variations. The sometimes apparently complicated forms of atmospherics are in most cases found to be a secondary effect caused by gradual deformation during transmission.

# Growth of Knowledge of the Ionosphere

IT is now well known that all long-distance radio communication takes place by the propagation of electric waves through the upper regions of the atmosphere which are embraced by the modern term 'ionosphere'. Although a conducting upper atmosphere was postulated in 1902, direct experimental evidence of its existence was not obtained until 1924. Since the latter date, a vast and increasing amount of research has been devoted to the ionosphere as a branch of theoretical and applied physics. While the major portion of this work has been conducted in Great Britain and in the United States, the fascination of the subject has attracted a number of research workers in other countries. The results of this work are generally recorded in the various scientific publications of the world. These publications are so numerous and so widespread, however, that the industrious worker in the subject is faced with a strenuous task if he is to study them all. Those whose main interest lies in other fields find it increasingly difficult to maintain an up-to-date knowledge on the ionosphere, and particularly to keep a clear perspective view of the progress which has been achieved and of its bearing on other fields such as meteorology and geophysics.

It is here that Prof. S. K. Mitra has come to our rescue with his "Report on the Present State of our Knowledge of the Ionosphere", which was prepared for the opening of a symposium organised by the National Institute of Sciences of India in 1935, and is now reprinted from the *Proceedings* of that body. This report presents in a connected and concise form the main results of both theoretical and experimental investigations on the ionosphere during the past twelve years. The work has been treated from a fundamental point of view, and it is not concerned with the science or practice of radio communication except in so far as radio methods are nowadays employed as a tool for the exploration of the upper atmosphere.

The first large section of the paper gives in a clear and concise manner the theory of the propagation of electric waves through an ionised gaseous medium, introducing in sequence the effects of the earth's magnetic field and of energy dissipation by collisions. The results of the theoretical treatment are illustrated by typical dispersion curves showing the effects of these quantities upon the refractive index and absorbing powers of the medium and on the polarisation of the transmitted waves.

Next, an outline is given of the three main experimental methods which have been developed for the study of the properties of the ionosphere. The two of these most widely used involve the emission of a radio signal with special characteristics impressed upon it, and the study of the echo signal upon its return from the ionosphere to earth. A description is given of the methods by which information is obtained, from such records, on the equivalent height of the ionosphere, and the density and gradient of ionisation. Indeed modern research based on a study of such records of received signals is providing us with a detailed knowledge of the structure of the atmosphere at heights above about 80 km.; such knowledge is at present unobtainable in any other way. Throughout the paper, typical results of this research are presented in graphical form, and an appendix provides a bibliography, which has the merit of being obviously selected on a critical basis rather than of being entirely comprehensive.

Prof. Mitra appears to have succeeded admirably in compressing a large volume of matter into a small space, and in a subject which is progressing as rapidly as that under discussion, this has necessarily involved omitting reference to many investigations, which although helpful in the general progress of the work, are of lesser fundamental importance. The report should prove of great use to those studying or carrying out research in this most fascinating subject.

# Bacteriological Grading of Milk in Great Britain

GRADING of milk was introduced in Great Britain in 1923. Producers who conformed to certain rules and attained certain standards for the milk they supplied were given the right to apply certain statutory names to their products. It was expected that both the public and the producers would benefit, the former by obtaining a more hygienic milk supply, the latter by an increased commercial return—hopes not altogether realised. After consideration and consultation respecting the working of the Order during the past seven years, the Minister of Health has decided to institute a new "Milk (Special Designations) Order, 1936"[1], which came into operation on June 1.

The new Order has two main objects—to transfer from the Minister to local authorities the duty of granting licences to producers of certain graded milks, and to improve and simplify the special designations of milk. The present designations are 'Certified', 'Grade A. (Tuberculin Tested)', 'Grade A' and 'Pasteurised'. It is considered that so many grades create confusion, and the designations of some do not give a clear indication of their nature. Accordingly it is proposed to reduce the number of grades to three—'Tuberculin Tested', 'Accredited' and 'Pasteurised'. 'Tuberculin Tested' is raw milk from tuberculin tested cows and will replace the existing designations 'Certified' and 'Grade A. (Tuberculin Tested)'; it may also be pasteurised. 'Accredited' milk will replace the present 'Grade A' milk, and like the latter will be raw milk from cows regularly inspected by a veterinary surgeon, but not tuberculin tested. 'Pasteurised' milk will, as at present, be milk which has been held at a temperature of 145°–150° F.

for 30 minutes. The new Order contains a number of other provisions and administrative requirements for carrying it out. As it will affect large numbers of people, Sir Kingsley Wood has also issued an explanatory Memorandum setting out in non-technical language the effect of the Order and the way in which it will work[2].

Bacteriological standards were prescribed for the various classes of graded milk under the Order of 1923, namely, 'Certified' and 'Grade A. (Pasteurised)' must not contain more than 30,000 bacteria per c.c. and must not contain coliform bacilli in 1/10 c.c., 'Grade A. (Tuberculin Tested)' and 'Grade A' must not contain more than 200,000 bacteria per c.c. nor coliform bacilli in 1/100 c.c., and 'Pasteurised' must not contain more than 100,000 organisms per c.c., and the conditions for sampling and testing were standardised by the Ministry of Health so far as possible, so that it was hoped that reasonably concordant results might be obtained by different analysts. It was found in practice, however, that reputable workers employing a similar technique obtained the most discordant results, and a critical inquiry into the validity of the methods available for the bacteriological grading of milk was carried out for the Medical Research Council by Prof. G. S. Wilson and his assistants[3]. It was found that the plate count test for numbers of bacteria breaks down on account of the irregularity of distribution and clumping of the organisms in the milk, so that, under the best conditions, on any count an allowance of ±90 per cent may have to be made. Much the same may be said of the coliform test, except for pasteurised milk, when it may be of some value, serving as an index of the efficiency of the processing if performed with the freshly pasteurised milk. The new Order, therefore, while prescribing plate count tests for raw 'Tuberculin Tested' and 'Accredited' milks until December 31, 1936, substitutes for them a methylene blue reduction test for these milks on and after January 1, 1937. In addition, a coliform test is prescribed for these milks. Plate counts are to be continued for 'Tuberculin Tested Milk (Pasteurised)' and for 'Pasteurised' milk, the method of carrying out these tests being the same as obtains at present (Memo. 139/Foods). The methylene blue reduction test was the subject of much experimental work by Prof. Wilson and his colleagues, and appeared to fulfil most of the requirements demanded of a test for routine grading of *raw* milk. It is a simple test, with a very small experimental error, can be carried out by relatively unskilled workers on a large number of samples, and requires little equipment. By means of it, milk can be classified into the three or four grades necessary on the basis of cleanliness, it affords a useful index of the keeping qualities and gives more information about the milk than does the plate count. Allusion is also made to the possible use of the phosphatase test of Kay and Graham for the detection of imperfect pasteurisation.

[1] Ministry of Health: Statutory Rules and Orders 1936. No. 356. 4*d*. net. Circular 1533. 2*d*. net. (London: H.M. Stationery Office, 1936.)
[2] Sale of Milk under Special Designations. Memo. 197/Foods. 3*d*. net.
[3] Medical Research Council. Special Report Series, No. 206: The Bacteriological Grading of Milk. By G. S. Wilson, assisted by R. S. Twigg, R. C. Wright, C. B. Hendry, M. P. Cowell and I. Maier. Pp. 392. (London: H.M. Stationery Office, 1935.) 7*s*. 6*d*. net.

# Transitional Cultures in the Stone Age

A STUDY of the late palæolithic, mesolithic and early neolithic periods, of which the conclusions point to the necessity of a reclassification and further refinement in the definition of their characteristic industries, is based by M. Laurent Coulonges on his exploration of the prehistoric sites of Sauveterre-la-Lémance (Lot-et-Garonne). His report on his excavations and discussion of the evidence are published by the Institut de Paléontologie Humaine (*Archives*, Mém. 14).

Two sites were under investigation. They are situated on either side of the Paris-Agen railway in the valley of the Lémance, a tributary of the Lot, in the Canton of Fumel in the north-east of the department. One of the sites consists of two rock shelters on the south side of a detached island of the Cretaceous limestone, known as Le Martinet. They were first brought to light in 1868 when the railroad was under construction. M. Coulonges began excavation here in 1923. The second site, situated 300 metres away to the north, is a rock-shelter on the north side of the Roc Allan beside the Périgueux road.

*Le Martinet*. On this site ten different levels were clearly to be distinguished. Its importance lies in the fact that here, for the first time, was found on one and the same site a stratigraphic succession of Upper Palæolithic, Mesolithic and Neolithic. Of the various levels, the first was archæologically sterile, as was the third; the second level is Upper Palæolithic, the fourth, fifth and sixth, Mesolithic, the seventh, Neolithic, and the eighth, Iron Age and Gallo-Roman, with sub-soil and soil above.

In regard to cultures, that of Level 2 is Upper Magdalenian, but with certain resemblances to Azilian, more especially the Azilian of the Dordogne, and it is, therefore, here regarded as a proto-Azilian. In the Mesolithic three stages are differentiated. Level 4 contains a characteristic Azilian industry in demonstrable relations to palæolithic types; and sharply contrasting with them is a considerable number of microlithic implements in a great variety of types in pygmy form. For this industry the specific name of Sauveterrian is adopted. It is followed in Level 5 by what is obviously the industry of a new race, differing in its culture and habits from the Sauveterrian. There is, for example, for the first time in this station, the evidence of a hut site. This is Tardenois I, and unlike Sauveterrian which clearly represents a local development, it is an intrusive culture from outside. In this the most typical and characteristic implement is the trapezoidal barb-point (*pointe-barbelure*). The industry is free from extraneous influence, a fact perhaps most patently indicated by the striking absence of the characteristic small triangular forms of the Sauveterrian.

The cultural break between Levels 4 and 5 is also marked in the fauna, the presence of the beaver and *Helix nemoralis* in quantity in Level 4 pointing to a period of humidity.

Immediately above Tardenois I is Tardenois II in Level 6. Here appear the true trapeze, half-moons, the small implements with transverse cutting-edge and the first indications in technique of the approaching Neolithic, to which the next level belongs.

Tardenois III, the first neolithic phase, appears in Level 7, in which there are several hut-sites, clearly of the same age, with an abundance of implements. The technique is essentially the same as that of the two preceding Tardenois industries, but the cores and scrapers are larger and the large burins, planes and picks, and other forms characteristic of a neolithic industry appear. There are no polished implements. Pottery, absent in the lower levels, is abundant. The forms cannot be reconstructed, owing to the fragmentary condition of the finds; but the ornament is either impressed with the finger, in relief, or incised in horizontal lines and bands, or in the incised ornament, in oblique lines. It resembles pottery with impressed or incised ornament from Spain, France (Gard, Aude, Drôme, Lozère), Swiss lake dwellings and the beginnings of æneolithic and bronze in Belgium. Art is represented by an important human mask in calcareous stone, resembling the figures of the menhirs, and a phallic bisexual object. The culture appears to be advanced neolithic, bordering on the æneolithic.

*Le Roc Allan.* Here on the second site no less than nineteen levels have been distinguished, extending from Magdalenian to the modern surface. Except in the Azilian and the Sauveterrian the deposits are thin. Impressions of leaves from Tardenois levels have been identified and indicate a vegetation in mesolithic times comparable to that of to-day—*Hedera, Ruscus, Ilex, Populus, Ulmus, Quercus, Corylus, Acer*. The industries of the various levels follow those of Le Martinet sufficiently closely to call for no special comment here.

The results of these excavations, and especially the stratigraphy of mesolithic industries, constitute a contribution of the first importance to prehistoric science. As M. Coulonges points out, not only does it throw light on the development of the Tardenoisian industry and on its differentiation and chronology in relation to other cultures; but it also makes possible for the first time the characterisation of a new industry, often confused with the Tardenoisian, namely, the Sauveterrian. The Tardenoisian itself, which has often been regarded, in the absence of stratigraphic evidence, as merely a form or type, must now be regarded as a widely distributed and distinct culture, not entirely microlithic, but one in which the trapezoidal implement, if characteristic, is associated with forms which conform to the normal in size. From this must be distinguished the Sauveterrian, an industry with which triangular microliths are associated, and derived from the Upper Palæolithic.

In Tardenois I two types are distinguished, a coastal which appears at Mugem in Portugal and in the Morbihan, with widely spread affinities, of which the racial type is seen in the short dolichocephals of Mugem, and a continental, which appears at Le Martinet and in the Tardenois of Central Germany, of which the racial type is the skeleton of Cuzoul de Gramat.

Since the distinction to be drawn between Sauveterrian and Tardenoisian has been pointed out, its existence has been notified from a large number of stations generally distributed over France. The racial type is the man of Roc-du-Barbeau (Dordogne).

The classification which M. Coulonges now proposes is as follows.

*Final Palæolithic:* (1) Upper Magdalenian; (2) Proto-Azilian.

*Mesolithic:* (1) Azilian, subdivided into a Perigordian facies and a Pyrenean facies; (2) Sauveterrian, subdivided into Extended Aurignacian, Extended Magdalenian (rare), and Final Azilian; (3) Tardenois I, subdivided into coastal and continental; (4) Tardenois II.

*Neolithic:* Tardenois III and the civilisations of the polished axe.

# Elements beyond Uranium

THE possibility of producing elements with atomic numbers greater than 92 was discussed in 1934 by Fermi and his colleagues, who found that nearly all the elements undergo some transformation when bombarded with neutrons, and it was claimed that, among the products derived from uranium in this process, two at least, with half-life periods of 13 minutes and 90–100 minutes, must lie in the unknown range beyond uranium.

In view of the fact that this claim was challenged by von Grosse and Agruss (NATURE, 134, 773, November 17, 1934), who declared that the 13-minute radio-element must be an isotope of protactinium, it is interesting to read in the April issue of the *Berichte der deutschen chemischen Gesellschaft* that Profs. Otto Hahn and Luise Meitner and Herr F. Strassmann have found substantial support for Fermi's contention by devising a satisfactory chemical method of separating the products of bombardment of uranium from known elements and to some extent from one another. Thus the so-called 13-minute and 100-minute products are both precipitated by hydrogen sulphide from strong acid solutions containing either platinum or rhenium as carriers, whereas elements Nos. 90–92 all remain dissolved. Moreover, they do not share with protactinium (No. 91) the characteristic property of co-precipitation with zirconium phosphate. Thus it is concluded that they are *trans-uranic* elements. That they are not themselves isotopes follows from the fact that they can be separated by means of sodium hydroxide.

Further examination has shown that the half-life periods have been incorrectly estimated, and that the longer-lived product is a mixture of homologues of the platinum group (Nos. 94–96). These can all be separated from eka-rhenium (No. 93) by precipitation in acid solution by platinum foil. Altogether five or six trans-uranic radio-elements have been detected, namely, two isotopes of eka-rhenium, two of eka-osmium, one of eka-iridium and perhaps one of eka-platinum, the corresponding half-life periods being 16 minutes, 2·2 minutes, 12 hours, 59 minutes, 3 days and about 3 hours. The first and third of these are produced only by 'fast' neutrons,

the others more readily by neutrons which have been delayed by passage through thick layers of water, paraffin and other hydrides.

The mechanism of the transformations is discussed at some length. Bombardment of an atom by a neutron will produce an element of lower atomic number whenever an α-particle or a proton is eliminated, but this effect will be counteracted or even reversed when the unstable product emits sufficient β-radiation. On the other hand, an initial decrease in atomic number may be avoided, either by the expulsion of a second *neutron* along with the bombarding neutron, or by the mere absorption of the latter without nuclear disintegration. These effects are produced by 'fast' and 'slow' neutrons respectively, and in both cases the initial products become stabilised by the emission of β-rays, with consequent increase in atomic number.

A plate showing three photographic exposures by the Wilson method in a magnetic field is given as evidence of the β-radiation of trans-uranic elements.

## Educational Topics and Events

BELFAST.—The Senate has decided to confer the honorary degree of D.Sc. on Prof. T. H. Milroy, emeritus professor of physiology, and Prof. W. B. Morton, emeritus professor of physics.

CAMBRIDGE.—It is proposed by the Buildings Syndicate that a site for a new School of Anatomy be assigned on the Downing Street site in the court surrounded by the Schools of Agriculture, Pathology and Biochemistry and the Molteno Institute.

D. R. Pye, of Trinity College, has been approved for the degree of Sc.D., and Miss M. J. Stephenson, of Newnham College, for the title of the degree of Sc.D.

Dr. E. A. Moelwyn-Hughes, of Corpus Christi College, has been admitted by incorporation to the degree of Ph.D.

Mr. F. T. Brookes, fellow of Emmanuel College and University reader in mycology, has been appointed to the professorship of botany vacant by the resignation of Prof. A. C. Seward.

The Cambridge Philosophical Society is holding an exhibition of historic scientific apparatus in the Old Schools on June 8–23. The exhibition will be opened by Lord Rutherford in the Regent House of the Old Schools on June 8 at 9 p.m.

LIVERPOOL.—The University is to confer the honorary degree of Doctor of Laws upon Mr. Harold Cohen in special recognition of his munificent gift of £100,000 for the erection of a new Library, and for his previous gifts to the endowment fund of the library, and to the Students' Union.

LONDON.—The University's great scheme for building on its Bloomsbury site to the north of the British Museum is in process of realisation. The 'senate-house block', comprising accommodation for the meetings of the Court, the Senate and its various committees, a conference room, small hall and the administrative offices, is, says the Principal's Report for 1935–36, nearing completion, and it is hoped that the first part of the move from the Imperial Institute building in South Kensington will be achieved during the coming long vacation. So, exactly a hundred years after its foundation by Royal Charter in 1836, the University will occupy a home of its own. From its foundation until 1900, the functions of the University were almost entirely restricted to those of examination, and examination statistics still figure prominently in its annual reports. In the past year, candidates numbered 44,274, as compared with 42,822 in 1934 and 16,906 in 1919. The number of students reading in colleges of, or affiliated to, the University was 13,364. External students registered as preparing for the University's external examinations exceeded 12,000, of whom 6,000 were preparing for various intermediate examinations and 4,000 for degree examinations. Among the numerous benefactions mentioned in the report, a significant item is Sir Montague Burton's gift of £500 a year for the partial endowment of the chair of international relations at the London School of Economics. Seeing that a large proportion of the students in attendance at the School are residents of countries outside the British Isles (37 per cent of the 911 full-time students in 1934–35 were from abroad) it is obviously desirable to maintain and, if possible, enhance the prestige of this chair.

THE Trustees of the Garton Foundation have awarded the Garton Foundation studentship in the social sciences for 1936 to Mr. Harold Barger of the University of London (University College). The studentship, founded in 1928 by the late Sir Richard Garton, is intended to assist students of exceptional capacity to devote themselves for a year or more to the study of social or economic problems of fundamental importance. It is open to British subjects, and is of the annual value of £400 and is offered every second year. Mr. Barger proposes to study the economic fluctuations in the United States since the Great War.

THE Committee of Award of the Commonwealth Fund fellowships has made the following appointments, among others, to fellowships tenable by British graduates in American universities for the two years beginning September 1936. Gordon Bowen (Liverpool and Glasgow), to the University of California, in geography; P. M. Butler (Cambridge), to Columbia University, in zoology; H. R. X. D'Aeth (Cambridge), to Harvard University, in botany; J. C. Dykes (Cambridge), to the California Institute of Technology, in engineering; R. G. Flood (Manchester), to the University of Chicago, in economics; Dr. G. C. Hampson (Oxford), to the California Institute of Technology, in chemistry; W. M. Honeyman (St. Andrews), to Columbia University, in medicine; J. C. Hornel (Edinburgh), to the University of California, in chemistry; Dr. M. S. Jones (Edinburgh), to the University of Pennsylvania, in medicine; Dr. W. B. Mann (Imperial College of Science and Technology, London), to the University of California, in physics; F. H. Morrill (Liverpool), to the Massachusetts Institute of Technology, in engineering; A. L. Percival (Cambridge), to the Massachusetts Institute of Technology, in engineering; Dr. Donald Purdie (Cambridge), to Stanford University, in chemistry; H. D. Springall (Oxford), to the California Institute of Technology, in chemistry; Dr. E. G. Taylor (University College, Swansea), to Brown University, in chemistry. The following have been appointed to fellowships tenable by candidates from the British Dominions: I. P.

Norval (South Africa and Oxford), to the Rockefeller Institute, Princeton, in botany; W. E. van Heyningen (Stellenbosch and Cambridge), to Harvard University, in biochemistry. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: C. R. Barnicoat (New Zealand), of the Department of Scientific and Industrial Research, Government of New Zealand, to the University of Minnesota, in dairy research; R. M. du Toit (Pretoria), of the Department of Agriculture, Government of South Africa, to the University of Minnesota, in veterinary science; R. G. Simmers (New Zealand), of the Department of Scientific and Industrial Research, Government of New Zealand, to the Massachusetts Institute of Technology, in meteorology; Dr. E. J. Underwood (Western Australia and Cambridge), of the Department of Agriculture, Government of Western Australia, to the University of Wisconsin, in agriculture.

## Science News a Century Ago

### The University of London

*The Times* of June 6, 1836, said, in the form of a quotation from the *Observer*: "As there seems to be some doubt respecting the progress of the arrangements for the constitution of the new Metropolitan University, we have much pleasure in announcing that the charter is already in a state of forwardness, and will probably be mature for promulgation in about a fortnight. In addition to Professor Airy, the Rev. Mr. Thirlwall and Mr. Senior, who, we were enabled to state some time since, would be members of the board of examiners, the public will be gratified to learn that the following distinguished persons are also to be among the number:—Mr. Lubbock, Vice-President of the Royal Society; Mr. Sheepshanks, of Trinity College, Cambridge; Dr. Arnold; and Dr. Dalton, the eminent chymist, of Manchester."

### Lyell and Sir John Herschel

ON June 7, 1836, Lyell wrote from 16 Hart Street, Bloomsbury, to Herschel, at the Cape, "A few days ago I sent to Captain Beaufort a long letter which I had written to you, in which I hoped to enclose some letters of introduction to persons at Rio, as you wished. I now enclose them, together with the abstract of Babbage's paper to which I alluded. . . . Yesterday I sat next Babbage at Miss Rogers' at dinner. . . . Mr. Rogers, the poet, was talking of your astronomy which he had read, as well as the introduction to 'Natural Philosophy', and with both of which he had been much delighted; and among other things, with the manner in which you had alluded to certain papers of Dr. Young's on light and colour, which Brougham has so contemptuously and unmercifully cut up in the 'Edinburgh Review'. . . . I think it was Sydney Smith who said of Brougham that he had made two great discoveries in the 'Edinburgh Review'—the first was that Byron was no poet, the second that Young was no philosopher."

### Brain of the Negro

IN a paper read before the Royal Society on June 9, 1836, Dr. Frederick Tiedemann, professor of anatomy and physiology in the University of Heidelberg and foreign member of the Royal Society, presented a paper on this subject, which he said was one of great importance in the natural history, anatomy and physiology of man, as well as interesting in a political and legislative aspect. His extensive researches had led him to the following conclusions: (1) The brain of a Negro is on the whole quite as large as that of the European and other human races. (2) The nerves of the Negro, relatively to the size of the brain, are not thicker than those of Europeans, as Soemmering and his followers had said. (3) The outward form of the spinal end, medulla oblongata, cerebellum and cerebrum of the Negro show no important differences from that of the European. (4) Nor does the inward structure, order of the cortical and medullary substance, nor the inward organisation of the interior of the Negro brain show any difference from that of the European. (5) The Negro brain does not resemble that of the orang-utan more than the European brain, except in the more symmetrical distribution of the gyri and sulci. In conclusion, Prof. Tiedemann maintained that neither anatomy nor physiology justified our placing the Negro beneath the European in a moral or intellectual point of view. (*Phil. Trans.*, 497; 1836.)

### Humboldt and Terrestrial Magnetism

THE foremost contributors to the knowledge of terrestrial magnetism in the early part of the nineteenth century were Hansteen, Gauss and Alexander von Humboldt. Born in 1769, Humboldt made his celebrated journey in Southern and Central America during 1799–1804, and from 1808 until 1826 resided mainly in Paris where he was the friend of Arago. Returning to Germany, in conjunction with Gauss, he organised the German Magnetic Union and vigorously impressed the importance of magnetic expeditions on both the Russian and British Governments. His letter on a systematic course of observations in various parts of the world was addressed to the Duke of Sussex, then president of the Royal Society. This was referred to Christie and Airy, who, on June 9, 1836, reported favourably upon it, strongly recommending the adoption of the scheme.

## Societies and Academies

### EDINBURGH

Royal Society, May 4, 1936. STEFAN JELLINEK: The theory of electrical traces (address). The external or superficial effects upon objects struck by lightning have long been known. These effects (or 'traces') are shown to be separable into three distinct geometrical types—the straight line, the circular and the spiral. In addition to the thermal and chemical action, it has been demonstrated that there is also a mechanical action.

### PARIS

Academy of Sciences, April 27 (*C.R.*, **202**, 1389–1468). DIMITRI RIABOUCHINSKY: The régime of velocities almost equal to the local velocity of sound. JEAN ANDRÉ VILLE: Indifferent frequencies. LÉON POMEY: The determination and the harmonic

properties of multiple points of a unicursal involution of any order. NICOLAS ABRAMESCO: The study of the form of a curve or a surface in the neighbourhood of one of its points. ALFRED ROSENBLATT: The conformal representation of plane domains. KAROL BORSUK: Groups of classes of continued transformations. FRÉDÉRIC ROGER: The distribution of certain limit directions and its application to the theory of functions with complex variable. CHARLES PLATRIER: The calculation of the energy of acceleration of a solid. FERNAND AIMOND: The energy of acceleration of a solid having a fixed point. PAUL DUMANOIS: A motor with heavy fuel, with constant pulverisation and with limited maximum pressure. ALBERT ARNULF: The ultra-violet spectrum of the night sky. Analysis of the results obtained with four negatives, one taken at the Jungfraujoch, the others at Villennes-sur-Seine. The lines measured range from 3556 A. to 3030 A.: below 3030 A., no lines could be proved with certainty. RENÉ DUGAS: The reality of quantic mechanics. JACQUES WINTER: The diffusion of Dirac waves. MAX GELOSO and MLLE. CHARLOTTE ROUILLARD: Experimental researches on the electrolysis of manganous salts. The oxide deposited varies in composition with the experimental conditions, but always contains less oxygen than the peroxide, $MnO_2$. NICOLAS KÜRTI, PAUL LAINÉ, BERNARD VINCENT ROLLIN and FRANZ SIMON: The installation, at the Bellevue electromagnet laboratory, of an apparatus for the liquefaction of helium and for obtaining temperatures below 1° K. by the magnetic method. Description and photograph of the apparatus. It has been found that at these low temperatures some paramagnetic salts become ferromagnetic. ROBERT GUILLIEN: The band $A$ in liquid oxygen. ETIENNE VASSY: The influence of temperature on the absorption spectrum of ozone. The absorption spectrum of ozone was proved to be independent of the pressure. Measurements of the absorption coefficient were then made at 20° C. and − 80° C. Applying this to the results previously obtained for atmospheric ozone, it is concluded that 85 per cent of atmospheric ozone is at a low temperature. NY TSI-ZÉ and WENG WEN-PO: The absorption spectrum of rubidium. PIERRE MONTAGNE: The evolution of reactions in systems in chemical equilibrium submitted to adiabatic expansion. GEORGES COSTEANU: The Raman effect of liquid ammonia and of solutions of nitrates in liquid ammonia. ANDRÉ BOULLÉ: The calcium metaphosphates. Proof of the existence of two crystalline varieties of calcium metaphosphate. PIERRE THOMAS and MLLE. C. KALMAN: The catalytic oxidation by copper salts in the presence of manganese salts. A. BOUCHONNET: The nitration of cellulose by nitric acid as vapour. Nitrocelluloses containing between 10·0 per cent and 13·7 per cent of nitrogen can be prepared by acting upon cellulose with the vapour of nitric acid under reduced pressure. PAUL CORDIER: The condensation of phenylpyruvic acid with acetophenone. RAYMOND QUELET and MLLE. YVETTE GERMAIN: The synthetic preparation of 3-nitro-4-methoxy-benzyl alcohol and of its ether oxides. RAYMOND PAUL: The hydrol character of furylphenylcarbinol. GUSTAVE VAVON and LOUIS BOURGEOIS: The reactivity and structure of the primary aromatic amines. JACQUES BOURCART: The evolution of the coast of the Iberian peninsula from the peninsula of Peniche (Portugal) to Cape Finisterre (Spanish Galicia). ROGER HEIM: The three Agarics with latex of the Madagascan flora. CONSTANTIN T. POPESCO: Researches on meandriform decortications. PIERRE CHOUARD: Some effects of light on growth, flowering, root formation and budding in various plants. RENÉ SOUÈGES: The embryogeny of the Droseraceæ. The development of the embryo in *Drosera rotundifolia*. LOUIS C. MAILLARD and JEAN ETTORI: The proportion of titanium in the bodies of mammals. Titanium was found in various organs from man, dog, horse and sheep. There appears to be no concentration in any special organ. GEORGES BLANC and MARCEL BALTAZARD: The longevity of the virus of murin typhus in the flea, *Xenopsylla cheopis*. Experiments showing that the rat flea may remain infected and capable of carrying infection during the whole of its life. PAUL F. ARMAND-DELILLE: The resistance conferred on the ape by the inoculation of an $S$ strain of human tubercle bacillus isolated by hæmoculture. G. RAMON and E. LEMÉTAYER: The value and duration of the immunity conferred by tetanus anatoxin in the vaccination of the horse against tetanus. More than 50,000 horses have been submitted to the anatoxin treatment, which has given good results. The immunity lasts several years. ANDREW WATSON SELLARDS and JEAN LAIGRET: A new demonstration of the efficacy of vaccination for yellow fever.

### AMSTERDAM

Royal Academy (*Proc.*, 39, No. 3; 1936). A. J. KLUYVER and J. C. HOOGERHEIDE: Some remarks on the reduction intensity of living cells. M. W. WOERDEMAN: 'Embryonic induction' by chemical substances. W. H. KEESOM and K. W. TACONIS: Structure of solid chlorine. Chlorine has a tetragonal molecular lattice, $a = 8·56$ A., $c = 6·12$ A., space group $D^1{}_{4}h$. L. S. ORNSTEIN, H. BRINKMAN and T. HAMADA: The mechanism in the positive column of a discharge. Interpretation of Hamada's measurements of the temperatures in the positive column. L. S. ORNSTEIN, D. T. J. TER HORST and G. H. FREDERIK: Change of the dipole moment of transformer oil through alteration during use. The oxidation during use can be followed by determining the dipole moment. J. de GIER and P. ZEEMAN: An eighth isotope of molybdenum. Discovery of an eighth isotope at 102. F. K. T. VAN ITERSON: Cavitation and surface tension (2). A discussion of the effect of impurities (oil, etc.) in water on the occurrence of cavitation. J. G. VAN DER CORPUT: Distribution functions (6). J. G. VAN DER CORPUT: Some Vinogradoff methods. E. COHEN and A. K. W. A. VAN LIESHOUT: Influence of mechanical deformation on the velocity of transformation of polymorphic metals (2). Influence of metallic admixtures. E. COHEN and H. L. BREDÉE: Negative coefficient of expansion of silver iodide. The results of Jones and Jelen are seriously in error due to their using physically impure material. E. COHEN and W. A. T. COHEN DE MEESTER: Studies on corrosion. E. ROSENBOHM and F. M. JAEGER: Localisation of the transition points of allotropic metals under various conditions by means of the Saladin–Le Chatelier method. E. ROSENBOHM and F. M. JAEGER: Measurement of the electrical resistance of metals as a function of the temperature by means of a twin galvanometer with photographic recording. Results for nickel between 320° and 430° C. F. M. JAEGER and J. A. VAN DIJK: Preparation and properties of some orthodiaminocyclohexanes. C. S. MEYER:

Some integral representations in the theory of Bessel and Whittaker functions. J. D. GEERITSEN and W. G. V. D. KLOOT: Differences in the flower-forming capacity of *Narcissus Pseudonarcissus* and *Hyacinthus orientalis*. M. G. RUTTEN: An interseptal canal system in the foraminiferal species *Discocyclina papyracea*, Boubée. L. BOOMGAART and J. VROMAN: Smaller Foraminifera from the marl zone between Sondo and Modjokerto (Java). C. D. VERRIJP and E. F. DRION: The frequency distribution of growth in homogeneous material (2). G. P. FRETS: Hereditary variability in the $F_3$ seed generation after cross-fertilisation of bean races.

### BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 32, No. 3, 1936). L. GODEAUX: (1) Algebraic surfaces possessing a simple linear system, the curves of which contain an involution. (2) Some involutions belonging to the generalised Humbert surface. J. E. VERSCHAFFELT: The course of the lines of constant affinity in phase transformations of a simple substance. Generalised thermodynamic treatment with special reference to supraconductivity and liquid helium. TH. DE DONDER: The 'discontinuity brackets' of Hadamard and van Mieghem. C. LURQUIN: The algebra of eventual variables (2). L. DERWIDUÉ: A congruence of twisted cubics. G. SOKOLOFF: Collision in the problem of three bodies which attract each other proportionally to their masses and to a function of the distance. E. DELPORTE: Discovery of a peculiar star at the Belgian Royal Observatory. The body, asteroid or comet, was moving in an orbit of high eccentricity and was rapidly decreasing in magnitude. W. H. BENEDICTUS: New application of the Maxwell – De Donder asymmetric electromagnetic tensor. H. VOGELS: Photolysis of nitrates (spectrophotometric determinations of potassium nitrite, catalytic action of manganous salts). Development of a method for estimating potassium nitrite from its absorption in the neighbourhood of 3650 A. E. ZUNZ: The action of derivatives of aminomethylbenzodioxane, of phenoxydiethylamines and of naphthoxydiethylamines on aqueous diurosis in the dog.

### MOSCOW

Academy of Sciences, *C.R.*, 1, No. 3, 1936. E. VORONOVSKAJA: A minimum problem in the theory of moments and the evaluation of polynomials. N. MOISSEJEV: On some anepicyclic regions in the asteroidal problem of three bodies. E. K. SAVOJSKIJ and B. M. KOSYREV: Changes in the absorption of weak electrical high-frequency fields by certain fluids, in connexion with the strength of these fields. K. S. TOPCHIJEV: *N*-methyl-pyridine-thiuram-disulphide. A. E. FERSMAN: Polar isomorphism. S. G. ZEITLIN: The borax content of oilfield waters. J. CHARIT, S. A. NEUFACH and K. N. MOROZOVA: Flavins and metabolism (3). Action of lactoflavin and methanol extract from the liver on blood glycolysis. A. J. ATABEKOVA: On some anomalies in atypical karyokinesis. A. G. ROMANKOVA: Parasitism of the mould *Penicillium rugulosum*, Thom., on *Aspergillus niger*. M. I. KNIAGINICHEV: Difference in the variation of the protein content in wheat and barley grains within one ear. A. J. TARANETZ: A short review of the genera related to *Stichaeus* from the Bering, Okhotsk and Japanese Seas.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Monday, June 8

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION, at 5.30.—Prof. Ernest Barker: "Education for Citizenship".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—C. P. Skrine: "The Quetta Earthquake".

### Tuesday, June 9

RESEARCH DEFENCE SOCIETY, at 3—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Annual General Meeting.

Sir Malcolm Watson: "Manson, Ross and Reed: Pioneers in Research in Tropical Medicine" (Tenth Stephen Paget Memorial Lecture).

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. S. P. Bedson, F.R.S.: "A Study of Psittacosis Virus and what can be learned from it concerning the Nature of Filterable Viruses".

### Wednesday, June 10

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. A. Kopff: "Star Catalogues, especially those of Fundamental Character" (George Darwin Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 6.—Dr. F. J. North: "De la Beche and his Activities, as revealed by his Diaries and Correspondence".

## Official Publications Received

### Great Britain and Ireland

Official Guide to the Gardens and Aquarium of the Zoological Society of London. By Dr. Julian S. Huxley. (New Series.) Pp. 116. (London: Zoological Society of London.) 1*s*. [85

World Power Conference. Annual Report, 1935. Pp. 13+iv. (London: World Power Conference.) [115

The John Innes Horticultural Institution, 1910–1935. Pp. 58. (London: John Innes Horticultural Institution.) [115

Experimental Researches and Reports published by Department of Glass Technology, The University, Sheffield. Vol. 18, 1935. Pp. iv+330. (Sheffield: The University.) 7*s*. 6*d*. [115

Education (Scotland). Report for the Year 1935 by the Director of the Royal Scottish Museum, Edinburgh. Pp. 13. (Edinburgh: Royal Scottish Museum.) [125

The Handbook of the National Institute of Poultry Husbandry, Newport, Shropshire. (Bulletin No. 11.) Pp. 52. (Newport: National Institute of Poultry Husbandry.) [125

Technical Publications of the International Tin Research and Development Council. Series A, No. 35: Research on Thin Layers of Tin and other Metals, 2: The Corrosion of Metals by Technical Insulating Oils. By P. J. Haringhuizen and D. A. Was. Pp. 16. (London: International Tin Research and Development Council.) Free. [135

Seale-Hayne Agricultural College: Department of Plant Pathology. Twelfth Annual Report for the Year ending September 30th, 1935. (Pamphlet No. 46.) Pp. 32. (Newton Abbot: Seale-Hayne Agricultural College.) [135

### Other Countries

Journal of the Indian Institute of Science. Vol. 18A, Part 18: Studies in the Proteins of Indian Foodstuffs. vii. Globulins of the Aconite Bean (*P. aconitifolius* Jacq.), and viii. On the Heat Coagulation of Globulins from *Vigna catiang*, Walp., and *P. aconitifolius* Jacq. By Miss K. Bhagvat. Pp. 137–151. 1.2 rupees. Vol. 19A, Part 1: The Sandal Seed, its Oil and Proteins. By Motnahalli Sreenivasaya and Nuggehalli Narayana. Pp. 8. 12 annas. Vol. 19A, Part 2: Studies in the Proteins of Indian Foodstuffs. ix. Digestibility of the Globulins from Cowpea (*Vigna catiang*, Walp.) and Aconite Bean (*P. aconitifolius*, Jacq.). By Miss K. Bhagvat and M. Sreenivasaya. Pp. 9–18. 14 annas. Vol. 19A, Part 3: Studies on Starches from Indigenous Grains and Tubers. Part ii. Jowar Starch, and Part iii. Ragi Starch. By H. P. Das Gupta. Pp. 19–29. 1 rupee. Vol. 19A, Part 4: Studies on Starches from Indigenous Grains and Tubers. Part iv. Cassava Starch; Part v. Starches from Different Varieties of Rice, and Part vi. Use of Tintometer in the Study of the Degradation Products of Starch. By H. P. Das Gupta. Pp. 31–43. 1.2 rupees. Vol. 19A, Part 5: Determination of Carbonate, Organic Carbon and Total Nitrogen in the Same Sample. By T. R. Bhaskaran, C. R. Harihara Iyer, R. Rajagopalan and V. Subrahmanyan. Pp. 45–52. 12 annas. (Bangalore: Indian Institute of Science.) [125

Annals of the Observatory of Lund. No. 5: Altitude Tables for Mariners and Aviators. By Erik Tillman. Pp. 45. (Lund: Observatory.) [155

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# The Protection of Scientific Freedom

WHEN the Academic Assistance Council was formed in May of last year to assist scientific and other scholars who, on grounds of religion, race or opinion, were unable to continue their work in their own country, it was hoped that its work might be required for a temporary period only. In co-operation with other emergency organisations, the Council has succeeded in permanently re-establishing 363 of the 700 displaced scholars who left Germany, and in providing temporary support for 324 others in universities and other institutions of learning while continuing their research. A feature of this work has been the ready co-operation which the Council has secured from practically all university institutions in giving an opportunity to those displaced of continuing their scientific and learned pursuits.

It is now clear that some permanent body is needed to assist scholars who are victims of political and religious persecutions. The devastation of the German universities still continues, and in Russia and Italy freedom of study and teaching in large portions of the field of learning are still proscribed. Within the past year in Portugal, a number of university teachers in various faculties have been retired on grounds of political opinion, and the Council has offered its assistance to them. In these circumstances the Academic Assistance Council has decided to establish as its permanent successor a 'Society for the Protection of Science and Learning', which will continue its various forms of assistance to scholars of any country who on grounds of religion, race or opinion are unable to carry on the scientific work for which they are qualified. The Society will be incorporated as a company limited by guarantee, and one of its functions will be to build up an Academic Assistance Fund to award research fellowships tenable in the Universities of Great Britain and other countries by the most distinguished of the refugee scholars.

The issue of this appeal is a pertinent reminder of the dangers to civic freedom and responsibility existing in some countries at the present time. Political events of the last four years have, moreover, struck heavy blows at the international solidarity of science itself. It is not merely the displacement of many workers of outstanding ability from Germany and other countries and the consequent enrichment of intellectual life elsewhere. The resulting impoverishment of scientific life is less disquieting than the effect of lopsided development of science in one such country on developments elsewhere. The prostitution of scientific effort on war purposes to the extent and intensity which we have been witnessing in Germany and Italy, for example, constitutes exactly that threat to peace which Major Lefebure pointed out in the "Riddle of the Rhine" in 1919 was to be found in the uneven development of chemical industry.

The position of the scientific worker under a dictatorship is in fact one of the greatest difficulties in the way of the formulation and acceptance of a code of professional ethics in such matters as the application of scientific effort in warfare. Even in Great Britain and in France, however, professional organisations have largely still to acquire the sense of civic or social responsibility which can inspire either the formulation of such codes or ensure their observance in practice. Scientific workers are rapidly becoming aware of the extent to which political organisations can affect the direction of scientific research, and even frustrate its efforts, but they have shown little sign collectively that they are aware of what is

demanded of them even in the interests of science itself.

The reason for this position lies in the failure to understand the nature of organised society and to recognise simple social truths which is a consequence of our neglect of training for citizenship. The scientific worker suffers on the whole more rather than less than other members of the community from this neglect. The very extent to which scientific factors enter into the problems of government and administration on any scale to-day make it as imperative that some training in citizenship should form a part of his training, as that the ordinary citizen should receive in his education at least a sufficient training in science to provide a background for the life he is called upon to live.

The task before us indeed is that of organising society from the civic or municipal through the national to the international plane, in accordance with a social policy which permits the fullest flow of creative thought and activity and the maximum enjoyment of the resources at our command. That task demands the fullest participation of the scientific worker, alike in ascertaining the facts upon which action must be based and in contributing to the vital creative thought which shapes new means and new policies adequate under the conditions of to-day. Unless he is prepared to co-operate, we may well see the gradual dying down of creative thought and activity no less in science than in the political and other fields.

The limiting influence of politics upon scientific work is in fact making itself felt at a time when the service men of science might render is of increasing magnitude and importance. Not merely are new fields of investigation opening up before him, such as the whole subject of population in its biological, statistical and social aspects, but also the spirit of disinterested inquiry, of unprejudiced search for truth and willingness to face and accept change which characterises the mind of science, are needed as never before. Until some of our major problems can be sifted out in this spirit, we are unlikely to regain our control over events.

Nowhere is this more true than of administration itself. The emergence of scientific management indicates that we are slowly coming to realise that organisation is a subject for scientific study and that there are definite principles which must be discovered and respected if we are to avoid the disintegration either of society or of industry under the influence of mechanisation and other forces. The science of management is as yet in its infancy, and probably no factor is more responsible for dissatisfaction, inefficiency and injustice either in industry or in society than the neglect of sound principles of management which have been discovered partly by experience and partly by deliberate investigation.

The knowledge that such principles exist and can be applied to overcome many of our difficulties is itself an inspiration to the scientific as to the social worker. Equally important with his contribution to the evolution of appropriate organisation is the stimulus which his willingness to accept and promote change can supply. It supplies a corrective to the inherent tendency to pay greater respect to the administration than to the creative function, and to the resistance to reintegration and adaptation of institutions which have outlived their utility or ceased to function. The kinship between the spirit of service and the spirit of science enhances the value of this contribution.

Moreover, with this willingness to face change, there is usually linked in the mind of science a capacity for continuous evolution by building on the past and modifying its institutions to meet the changed conditions, which offers a means of building a new social order without recourse to the violent and revolutionary measures adopted in some countries. Within our existing framework the continuous and impartial application of existing knowledge might do much to establish such an order and evolve new and more creative standards of life and thought.

The participation of the scientific worker in this task is not merely a matter for the individual. Education in citizenship may indeed make him more aware of his responsibilities and opportunities and lead him to participate more fully in civil and social life. It is, however, professionally that his major contribution will still be rendered, and professional organisations occupy a place in society of decisive importance. Without this assistance we may look in vain for the emergence of leadership of an adequate calibre or for that close relation between knowledge and power which alone can avert catastrophe. It is mainly from within their own rank that men of science will find the support that enables them still to maintain the vital freedom of thought and investigation without which assuredly our present civilisation is doomed. The Society for the Protection of Science and Learning should at least ensure that that support is maintained, and indeed augmented.

# A Treatment of Modern Physics

**A Treatise on Modern Physics:**
Atoms, Molecules and Nuclei. By Prof. M. N. Saha and N. K. Saha. Vol. 1. Pp. xii + 856 + 12 plates. (Allahabad and Calcutta: The Indian Press, Ltd., 1934.) 30s.

THERE are two chief ways of writing a book on modern physics. Either an attempt may be made to include every piece of work of any interest, with the aim of enabling the reader to find out what has been going on in every corner of the subject, or one may endeavour to pick out, from the enormous mass of material, really significant and important threads, which guide the advances of the present and immediate future, and rely on references to monographs and books on special branches of the subject to supplement a small chosen body of reference to original papers. The former is the method of the German 'handbooks', and necessitates the allotting of the work to many hands, and, almost inevitably, a lack of balance, proportion and uniformity. The second, and probably harder, method is more the English and American tradition, as exemplified, in different ways, by the "X-rays and Crystal Structure" of the Braggs and Richtmyer's "Introduction to Modern Physics". It demands rigid selection, a strong critical sense, a personal style and, above all, a uniformity of treatment. This does not mean that all parts must necessarily be of the same standard of difficulty, but that a certain standard of equipment and accomplishment must be kept in mind as that of the supposed reader.

The book before us is intended, we suppose, to belong to the second class. It is based, according to the preface, on lectures to Indian B.Sc. (Hons.) and M.Sc. students, and aims at being "concise, up-to-date and self-contained". A second volume is in active preparation, which, if of equal bulk, will bring the work up to 1,700 large pages, or more than three times the size of Richtmyer, so that the conciseness is only relative to, say, a German 'handbook'. This matter of size is typical, perhaps, of what appears to be a great weakness of the book, in that it is neither one thing nor the other, a short readable treatise or a complete reference book. Further, the bulk is largely brought about by a lack of proportion and uniformity of treatment, for while some subjects, such as complex spectra, are treated on the 'handbook' scale, others, of undoubtedly greater importance, are only just touched. Up-to-date it is not; we must await the second volume before we can judge if it is self-contained.

The chapter on "Positive Rays", for example, consists of twenty-one pages, and practically all that is said about the method of anode rays, used by Aston for so much of his classic work, is that it has been used for sodium and potassium "on account of the ambiguity due to multiply charged ions which are very often present" in the ordinary method. Of the general method of anode rays, and of what really necessitates its use, nothing. The difficulties that necessitate the devices described are passed over, Bainbridge comes in for a passing reference only, nothing at all is said of Aston's methods of precision, first published in 1927, nor of the measurements of the departures from the whole number rule. There can be little doubt that this is one of the most important researches in modern physics, especially in connexion with the energies involved in atomic transmutations. Incidentally, in the account of the positive electron which closes the chapter it is, perhaps, scarcely just to say, in reference to Anderson's early work, "A repetition of these experiments by Blackett and Occhialini has fully confirmed this discovery".

This treatment of positive rays is, then, woefully incomplete, and what is there is not very good, for the stress is not laid on the right points. Again, taking the chapter on "Magnetism and its Theories", to which fifty pages are devoted, there is practically nothing on ferromagnetism, no mention is made of the magneto-caloric effect, or of magneto-striction, and the deduction of Langevin's diamagnetic formula is not as plain as the authors appear to think. It is clear that what interests the authors, to the exclusion of other fundamental matter, is the incidence of spectroscopic theory, as exemplified by the results on susceptibilities and on the gyromagnetic effect.

Against this grudging attention to positive rays and magnetism we have 449 pages devoted to line spectra, optical and X-rays; nothing at all is said in these pages of band spectra. The main treatment of bands is probably postponed to the next volume, but it would have been well to mention their existence in the introductory matter on spectra. Much of this part of the work is on a specialist scale: for example, nearly a hundred pages are devoted to the analysis of complex spectra, which is scarcely a subject for the ordinary honours

student at all, since success in it is, perhaps, a matter of the application of complicated empirical relations rather than of simple fundamental principles. The task—by no means an easy one—which the authors should have had before them in this part of the book is, starting from the beginning, to lead the reader up to the modern wave-mechanical view of the extranuclear structure of the atom. Since spectroscopic research has, during the last few years, been consolidating conquered ground rather than making sensational advances, there was an opportunity here to render a great service by subjecting our knowledge to a critical survey which should show the fundamental necessity and service of the different quantum numbers, in an ordered way. The general arrangement, however, does not make for simplicity of exposition, and principles are almost completely neglected in favour of detail.

We start with Bohr's original theory for hydrogen-like atoms, with circular orbits, and then go straight on to the fine structure of the Balmer lines with Sommerfeld's relativity correction considered at length. Here the selection principle is introduced in a few lines, with a reference to the Correspondence Principle which is never mentioned again. We are in the middle of a detailed discussion of the fine structure of helium lines, by the old method, without any explanation of the meaning of the $p$'s and $q$'s, or any mention of separable variables, before the significance of the second quantum number has ever been properly discussed; using the Russell-Saunders notation, which is here taken up after starting with the Paschen notation; and with intensity tables of which we are promised a subsequent explanation, not to be found in this volume, at any rate. This is, in fact, the only mention of intensities in the whole discussion of spectra. The student is then brought back to the doublet spectra, where he is introduced to the diffuse and sharp series, and told that some lines are not included in those two series, but will be dealt with in a later section.

The inner quantum number is first mentioned in the next chapter, which is devoted to Group II elements, on the ground that it is necessitated by the selection principle. After this we pass on to the Zeeman effect, and a detailed discussion of the Stern–Gerlach effect, still without any clear discussion of the elements of the quantum theory of spectra. The spinning, here called rotating, electron is then introduced for the first time, and so much reality is attributed to it that Abraham's old calculation of the ratio of mechanical to magnetic moment is quoted, without any indication to the student that this depends first of all upon an arbitrary distribution of electricity within the electron, and, secondly, upon the application of macroscopic methods to the electron, which is scarcely in accordance with modern ideas. The peripheral velocity is even worked out on these lines, and the absurd value which results is said to be unexplained. Surely the correct view is that expressed by Goudsmit himself, when he says: "The electron obtains a magnetic moment together with this rotation. How large this is cannot be predicted, since our information concerning the structure and properties of the electron must come from experiment." This is rather an essential point, since our authors tend to present many points as very much more a matter of deduction than they are, and frequently say that somebody "showed" something when they mean that he assumed it. From a didactic point of view this is particularly to be regretted.

The decisive points are, in fact, too often slurred over. Thus the $l$-$s$ coupling, and even $l=k-1$, are introduced without any explanation, and then dropped until the whole question is taken up again much later under the heading "Periodic Classification". We are given fourteen pages of the theory of the Stark effect, first by Epstein's method, and then by Bohr's method, but we have had no explanation of what is meant by angle variables, we have never been told, even roughly, what Bohr's perturbation theory is, or had Bohr's method of quantising contrasted with Sommerfeld's, or even been told what is meant by a degenerate system. We have, in fact, a mass of detail that can be found, if required, in the old books, and no exposition of the fundamentals, designed to help the reader to understand it. As further examples of how fundamental matters are treated we note that while there is a great deal about Schrödinger's and Van Urk's work on penetrating and non-penetrating orbits, there is only a passing mention of Schrödinger's wave mechanics equation, and no mention at all of the modern methods of estimating electron distribution, as exemplified by Hartree's self-consistent field, for instance. The Uncertainty Principle is only once mentioned, in small type. There is no attempt to discuss the methods of wave mechanics.

When we turn to such matters as the chapter on Röntgen rays, we have a good exposition of the elementary work on crystal structure, but little attention is paid to the work of the last ten years or so. The chapter on elementary radioactivity is good in many respects, but here again we note omissions of important matter. Possibly many points that we should have expected to find here are dealt with in the chapter on nuclear physics in the volume that has not yet been published.

I cannot help feeling that this book is on wrong lines, and, with Prof. Saha's name and fame to recommend it, may do much to further in India a method of teaching which I hold to be pernicious, the piling up of masses of complicated and imperfectly explained detail and the neglect of general principles and fundamental difficulties. We all rejoice in the rapid strides which Indian science is making, and I wish that I could greet this new evidence of activity with more encouraging words. The learned authors have perhaps wished to undertake too much. A more vigorous pruning and more attention to balance, and to the fundamentals of experiment and theory, would have sufficed to make the book easier to read, and this notice easier to write for a well-wisher.

E. N. da C. A.

# Tungus Shamanism

**Psychomental Complex of the Tungus**
By S. M. Shirokogoroff. Pp. xvi + 469. (London: Kegan Paul and Co., Ltd., 1935.) 50*s*.

THERE are some notable additions to our knowledge of Tungus culture, particularly in the sphere of Shamanism, in this work. It is the more regrettable that the author's valuable first-hand observations among Siberian and Manchurian tribes should be accompanied, and to a certain extent obscured, by long and rambling theoretical disquisitions, couched in a novel and often ambiguous terminology. Their elimination would have reduced an unwieldy volume, measuring 11in. × 14½ in. and weighing 8½ lb., to convenient proportions.

The title itself raises a number of questions. The author states that by the term "psychomental complex" he names "those cultural elements which consist of psychic and mental reactions on milieu", elements which "may be classified into two groups, namely, (1) a complex of reactions of a permanent and definite character, though they vary within a certain range, and (2) a complex of ideas which define certain mental attitudes and which may also be regarded as a theoretical system of the given unit (or even person)" (p. 1). Later, anticipating that the term "psychomental complex" is "likely to meet with opposition", he writes: "It is evident that we shall deal with a complex. I call it *psychomental* because the phenomena designated as *mental* may be regarded so only abstractly, while they are actually connected with the whole psychic complex of the ethnical units and individuals. This complex is functional complex", etc. (p. 46).

M. Shirokogoroff is very critical of psychological analysis as applied to ethnography, regarding it as "a technical method par excellence" which "must not be abused" (p. 8), but since the mental life of the Tungus forms the subject-matter of this book, a more conventional use of psychological terms would certainly have clarified both the argument and its exposition. The omnipresent term 'complex' is especially confusing; it may denote what is commonly called a culture, as in "alien complex" (p. 11), or a single element of material culture, as in "complex of winterfurcoats" (p. 21), or the psychological characteristics of individuals, as in references to an investigator's "own complex", "personal complexes" (p. 4) and "sympathy-complex" (p. 3). Linguistic shortcomings are easily forgiven an author writing in a language not his own, but M. Shirokogoroff invites a careful scrutiny by his frequent criticisms of generally accepted terms.

The foreword paints a gloomy picture of contemporary ethnography, and in the first chapter of the introduction there is a comprehensive indictment of the methods and theories of social anthropologists. Thus, Frazer and "L. Bruhl" are "mosaicists" (p. 8). The contributions of Malinowski and the "new psychological school" are dismissed in a paragraph (pp. 7–8), but with the following note: "It is clear that my use of the term 'functional' is much wider than that adopted by S. [sic] Malinowski and his followers . . . A full 'meaning' of my use of these terms will be clear after the reading of this work" (p. 8, n.**).

The author devotes the second chapter of the introduction to an outline of his "theory of ethnos", which he considers an indispensable "introduction to the psychomental complex" (p. 12). This theory is given a purely abstract formulation, with the aid of mathematical symbols and physical metaphors. The theory is not illustrated by any analysis of specific cultures and the thirty-three diagrams cannot be intended to represent even *hypothetical* communities, since the dots are concentrated along the outer margins of the areas assigned to the "ethnical units" in Series I, II and V.

Part One, "Positive Knowledge", deals chiefly with Tungus nature-lore. Anthropologists will regret that the author decided to confine himself "to the description and analysis of inferences without reproducing . . . the total amount of facts gathered" (p. 49), for the inferences are sometimes highly speculative, as in the paragraph about

"Animus" (p. 50), sometimes platitudinous, as in many of the remarks about paths (pp. 68–69). Much more could probably have been gleaned from a few verbatim native statements.

In Part Two, "Hypotheses", and Part Three, "Practical Consequences of Hypotheses", M. Shirokogoroff gives a valuable account of Tungus religious ideas and practices, although he will not countenance the terms 'religion' or 'magic' for Tungus phenomena (pp. 46–47). Chapter xvii, called "Souls and Their Managing", describes the disposal of the dead. The author regards Part Four, "Shamanism", as essentially a continuation of Part Three, both being concerned with "various methods of practical solution of problems resulting from the recognition of a series of hypotheses expounded in Part Two" (p. 241). Students of Shamanism, whether or not they endorse this theoretical approach, will find a great deal of useful information in this latter half of M. Shirokogoroff's work, particularly when the tribe to which the observations relate is indicated, as for example in the description of *chorea imitatoria* cases (p. 248), of occasions for shamanising (pp. 311–314) and of individual shamans (pp. 383–385). The absence of such indication for the greater part of the material in the book is apparently due to the underlying assumption that a Tungus "psychomental complex" exists, that there are combinations of traits and attitudes equally characteristic of these widely scattered tribes, living under varied conditions, whose only objectively established relationship is linguistic. Supporting this assumption there is only the author's subjective conviction that he "could directly penetrate into the Tungus complex", that "*all Tungus notions were understood in the Tungus system and mind, in the Tungus complex*" (p. 40). E. J. L.

# Mammals of Ceylon

**Manual of the Mammals of Ceylon**
By W. W. A. Phillips. Pp. xxvii + 373 + 38 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd., 1935.) 10 rupees; 15*s*.

THE author occupied his time, while a prisoner of war in Turkey, in collecting and observing the animals near his camp. Since his release, he has employed his leisure in a similar study of the mammals of Ceylon. A catalogue issued by a great museum enumerates all the species of the organisms belonging to a few or a single family, and is founded necessarily on the specimens in its own and in other museums; it is hence largely morphological and classificatory. In contrast a 'local' monograph such as this requires of its reader a certain acquaintance with the locality and its environments, and lays its main stress on the adaptation of the described species to these.

In Ceylon there are 109 species of mammals, and they are briefly classified into sub-orders, families and genera. The fur, colour, sexual difference and variation in size of each species are described, so that they are easily recognisable. Then the reader is taken to the living animals and made to consider at greater length the distribution of each species in Ceylon and elsewhere, its food, breeding and habits. These sections show the author to be a naturalist of high attainment and great enthusiasm; their value, since Ceylon like every other country is evolving, with consequent extension of human occupation and restriction of wild Nature, cannot be over-estimated. We venture to select at random those relating to the lorises, the sloth-bear, the mole-rat and the pangolin, feeling how aptly they may be used to illuminate many a dull lecture.

Of especial interest is the chapter dealing with the distribution. In Mesozoic times, Ceylon was part of Gondwanaland, which was broken up before the Tertiary period. Then there would seem to have been a temporary connexion in the late Eocene. In the Miocene, Ceylon was a much smaller island, and there may have been a renewed connexion in the Pliocene. In the early Pleistocene there was a subsequent invasion from India followed by subsidence, re-elevation and land connexion, finally the topography as we see it to-day. These four land connexions each provided its quota of mammals, which are now distributed in three climatic regions of Ceylon, namely, the dry zone influenced by the north-east monsoon, the wet zone by the south-west, and the wet central mountain zone. Each has its appropriate fauna, outside which it is seldom found, the mountains being the stronghold of the 'relics'. There are a very few forms common to all three, most of which have a local race in each zone. This is entirely contrary to the teaching of "Age and Area" (Willis), but 109 Ceylon mammals cannot be compared with about 2,800 species of plants, especially since the organisation of animals usually requires even minute adaptations to enable them to survive both varying physical conditions and the ravages of their carnivorous brethren and of other vertebrates.

**The Story of the Plant Kingdom**

By Prof. Merle C. Coulter. Pp. ix + 270. (Chicago: University of Chicago Press; London: Cambridge University Press, 1935.) 13s. 6d. net.

THIS book forms an eminently readable introduction to botanical science. It is intended primarily for the use of students at the University of Chicago, but should appeal equally to all those who are anxious to gain some knowledge of the structure and life-histories of representatives of the principal groups included in the plant kingdom. The American terminology and phraseology employed by the author may be found to be a drawback by students reading for examinations in Great Britain, but that should not deter those who are interested in the subject for its own sake.

After being introduced to the blue-green algæ, the reader is able to follow the various forms of internal and external differentiation of the plant thallus and the reproductive processes exhibited by selected members of first the green, and then the more complex brown and red algæ. Typical saprophytic and parasitic fungi are next described, after which the author gives an account of the life-histories and increasingly elaborate plant bodies of typical Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

Special emphasis is laid on the various specialisations of the higher plants by means of which they are particularly adapted for life on land. The phylogenetic treatment is, however, interrupted by a very clear account of the principal physiological processes in plants, and a chapter dealing with bacteria and the part they play in the nitrogen and carbon cycles. There are also chapters dealing with "The Process of Organic Evolution", "Classification" and "Seed Distribution and Germination".

The book is profusely illustrated by excellent line drawings and photographs. Minor errors worthy of attention are: (1) the term "spore" is inappropriate when applied to the asexual reproductive bodies of *Phytophthora infestans*, because these bodies, which are commonly referred to as 'conidia' or 'sporangia', sometimes give rise to zoospores instead of germinating directly; (2) the word 'tube' on p. 202 and the headline on p. 153 contain misprints. These points, however, do not seriously detract from an otherwise excellent book. C. R. M.

**Annual Reports on the Progress of Chemistry for 1935**

Vol. 32. Pp. 527. (London: Chemical Society, 1936.) 10s. 6d.

THE Annual Reports for 1935 fully justify anticipation; and this is an attainment of substance, since the standard which has been set by previous annual issues is indeed high. The whole field of chemistry cannot, of course, be covered; hence the selection of groups of topics is related to the interests of the reporters, and the volume catches something of the charm of personal commentaries.

Dr. H. J. J. Braddick discusses radioactivity and sub-atomic phenomena, and includes a section on cosmic radiation. Dr. C. B. Allsopp, Dr. S. Glasstone, Dr. E. B. Maxted, Dr. E. A. Moelwyn-Hughes and Dr. G. B. B. M. Sutherland deal with a number of problems in general and physical chemistry; a good deal of attention is given to the behaviour of deuterium and its oxide, 'heavy water'. Inorganic chemistry is discussed by Dr. S. R. Carter, Dr. E. S. Hedges and Dr. W. Wardlaw, who start by examining the evidence on which claims to the discovery of new elements have in recent years been made, and then turn their attention to the chemistry of certain selected elements and compounds, and to a review of non-ferrous alloy systems. The progress of crystallography over a period of two years is described by Dr. J. D. Bernal, Miss D. M. Crowfoot, Dr. R. C. Evans and Mr. A. F. Wells. Organic chemistry is entrusted to Dr. E. H. Farmer, Dr. E. L. Hirst, Dr. R. P. Linstead, Dr. S. Peat, Dr. F. S. Spring and Dr. E. E. Turner. The chapter on biochemistry is written by Mr. A. G. Pollard, Dr. C. P. Stewart and Miss J. Stewart, while analytical chemistry is reviewed by Mr. G. U. Houghton, Mr. L. S. Theobald and Dr. R. W. West.

It would be easy, but not very profitable, to list a number of intriguing matters which catch the eye as the pages are turned over; the development of spot tests, the accumulation of knowledge concerning vitamins and hormones, the phenomena of polymerisation, the problems of illinium, masurium, virginium, and alabamine. It must, however, suffice to repeat what has often before been said: that these are reports which chemists study as a matter of course, and that others will find in them an acceptable picture of progress in that branch of science. A. A. E.

**Z Dziedziny Nauki i Techniki**

Tom 6: W Poszukiwaniu istoty Życia: Historja naturalna Jednego Pierwotniaka. Napisał Prof. Dr. Jan Dembowski. Pp. xii + 356 + 8 plates. (Warszawa: "Mathesis Polska", 1934.) zl. 14.

PROF. DEMBOWSKI'S "In Search of the Nature of Life" is a second edition, greatly enlarged and brought up to date, of his book "The Natural History of a Protozoon", published about twelve years ago. The author tries to describe the problems of general biology, taking *Paramecium* as his example. In a series of chapters he discusses some technical problems of culture, the structure of *Paramecium*, movements, tropisms, the uptake of food and excretion, respiration, reproduction, variability and heredity, psychological phenomena.

The author has the very unusual gift of expressing complicated problems in a simple and attractive way, with a fine sense of humour, and moreover he never distorts the scientific truth. His dramatically written story of *Paramecium*, which "belongs to an old, aristocratic family, whose ancestors lived in times when man did not yet exist", is delightful reading for a scientific worker, who will find some new and interesting points of view. The layman and the student of biology will learn of many interesting problems and facts. W. W. N.

**The Annual Register:**
a Review of Public Events at Home and Abroad for the Year 1935. Edited by Dr. M. Epstein. Pp. xiv+319+190. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 30s. net.

To condense into some three hundred pages the history of the world in such a troubled year as 1935 can have been no easy task, but it has been achieved in this invaluable book of reference.

About a third of that space is occupied with the story of events in Great Britain told admirably in narrative form, not lacking in colour and relief but wholly free from bias. This is followed by a short section on Imperial history and a section on foreign history, including a review of the work of the League of Nations during the year. Nothing of importance in political history appears to be omitted, and the whole is readable as a continued story.

The second half of the book opens with a chronicle of important events in social history, followed by a lengthy retrospect of literature, art and science with mention of the more important books of the year and extended reviews of about two dozen. Art, drama, cinema and music receive ample notice and science is condensed into fourteen pages, a terse summary of research and discovery grouped under biological and physical branches. Then comes a review of finance, commerce and law and finally many pages of obituary notices of prominent men and women.

Certain public documents are, as usual, given in full: they include Herr Hitler's announcement of military conscription in Germany, the British, French and Italian notes relating thereto, and the Franco-Soviet Treaty of Mutual Assistance. The value of the volume is enhanced by a detailed index.

**Communication Networks**
By Prof. Ernst A. Guillemin. Vol. 2: The Classical Theory of Long Lines, Filters and related Networks. Pp. vii+587. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 37s. 6d. net.

THE latest developments of the filter question are now made available in English, together with the most useful parts of the more difficult classical treatments by Zobel. It will be recalled that, starting with Campbell, the properties of filter sections of specified patterns were tabulated for procedure in design, which, after all, is the important aspect for the communication engineer; the actual design along these lines was, however, an art, in that many tries were often necessary for a satisfactory solution to the problem. Starting again with Cauer, the procedure previously based on deductions from transmission line conceptions gave way to conceptions based on obtaining network structures having specified impedances, using a theorem by Foster and the most general of filter structures, the lattice. Guillemin's second volume is therefore of considerable practical importance. Transient phenomena in filters are adequately dealt with, together with Bode's methods of impedance control. L. E. C. H.

**British Calendar Customs**
England, Vol. 1: Movable Festivals. By A. R. Wright. Edited by Dr. T. E. Lones. (Published for the Folk-lore Society.) Pp. xvi+212+8 plates. (London: William Glaisher, Ltd., 1936.) 12s. 6d. net.

THAT eminent folklorist, the late A. R. Wright, had made the collection of evidence relating to British calendar customs a lifelong pursuit. The much desired publication of a selection from this material has now been made possible through the Folk-lore Society by the generous assistance of his widow. The editor, with wise judgment, has elected to deal with the movable feasts as a whole in chronological order, thus avoiding the complications and difficulties which arise when an attempt is made to fit them into the framework of the ceremonies of a fixed calendar. At the same time, it is obvious that this method of dealing with the material has the disadvantage of detaching from one another seasonal practices, which are clearly related. This, however, is an inconvenience in critical study which will be reduced to a minimum when the later volume covering the fixed festivals appears. It will, therefore, be an advantage to postpone the more detailed examination of the material until this is available. Meanwhile, it may be noted for the information of the student that this volume, in addition to Shrovetide, Easter and attendant observances, Ascensiontide and Whitsuntide, covers movable festivals not dependent on Easter, and also some harvest customs.

**Evans' Recent Advances in Physiology**
Fifth edition, revised by Dr. W. H. Newton. Pp. xii+500. (London: J. and A. Churchill, Ltd., 1936.) 15s.

SUCCESSIVE editions of a successful text-book are apt to lose something of their freshness. New wine is added to the dregs of the old, and though the store of knowledge grows, its flavour deteriorates. Books which deal with the recent advances of science cannot be compounded in this way, and each new edition must represent a fresh vintage.

"Recent Advances in Physiology" was first written by Lovatt Evans in 1925, and three new editions have been written by the same author. W. H. Newton has written the fifth edition. There is very little left in the book that has survived from the first edition. One of the chapters has the same title and some of the same figures, but the rest of the book is the new wine of physiological advance. Lovatt Evans has contributed an introduction, and a chapter on the metabolism of cardiac muscle. Newton has written new chapters on carbonic anhydrase, the oxygen supply of the fœtus, the sex hormones, chemical transmission at nerve endings, the spinal reflex, the secretion of urine, and the nervous control of micturition and defæcation. He has rewritten the chapters on the coronary circulation, the carotid sinus, carbon dioxide in the blood, and on conduction and excitation in nerve. The publishers are to be congratulated on having discovered a physiologist with the gifts, and the energy, to prolong the vigorous life of this well-known text-book for advanced students.

# Light and Temperature and the Reproduction of Plants*

By Prof. V. H. Blackman, F.R.S.

### EFFECT OF TEMPERATURE

THE thermal effect, that of chilling, now to be considered, is one which is being closely investigated by numerous biologists. It is truly cryptic in nature, for the effect of the temperature change may long remain hidden, only showing itself at the time of flowering many weeks later. The process of chilling young plants in order to accelerate flowering appears to have been used by an investigator in the United States before 1857 to secure the early flowering of wheat; but it was first investigated by Gassner in 1918 in his study of the differences between spring and winter cereals. It is well known that a winter variety of wheat or rye if sown in the spring will usually not flower, that is, will not produce an ear at all during that season or will ear so late that no satisfactory crop can be harvested. Spring cereals, however, have not this disability. Gassner conceived the idea that delay in flowering of the spring-sown winter wheat might be due to the lack of exposure to chilling which the winter sowing ensures. Accordingly he exposed seedling plants of winter wheat for thirty days to a temperature a little above freezing point, with the result that they flowered about the same time as the spring varieties. The effect that may be produced is shown in Table II.

TABLE II

Winter Cereals and Temperature of Germination

| Sowing date | Date of ear appearance 15–20° C. | Date of ear appearance 2–3° C. | Days early |
|---|---|---|---|
| | Wheat | | |
| December 18 | June 16 | June 9 | 7 |
| March 3 | August 13 | July 23 | 21 |
| April 15 | September 18 | August 10 | 39 |
| April 25 | No earing | August 11 | (infinite) |
| | Rye | | |
| January 9 | June 2 | June 2 | 0 |
| February 6 | June 9 | June 9 | 0 |
| April 15 | August 4 | June 18 | 47 |

The method of chilling seedlings employed by Gassner is of course quite impracticable on an agricultural scale, since the delicate seedlings could only be sown with the most careful individual handling. It is evident that if the method is to be of any practical use some modification is essential. Such a successful modification has recently been achieved in Russia. There the growing season may be short, not only from delay in sowing owing to the lateness in the rise of the soil temperature, but also owing to excessive heat. In the semi-arid zones of the Ukrainian steppes, for example, a period of great heat sets in during summer, and if the crop has not then ripened the plants are damaged, and the yield is very small. The modification in the chilling process which has been introduced by Russian botanists consists in exposure to the low temperature at a very early stage and under conditions which prevent almost entirely the growth of the embryo of the grain.

The grain is not fully soaked, but enough water is supplied to bring its moisture content up to fifty per cent of the dry weight of the seed. The amount of water must not be much less or the life processes in the embryo will not be sufficiently active to respond to chilling; the amount must not be much more or the embryo of the grain will develop too far. After the grain has been allowed to take up during twenty-four hours the appropriate amount of water at an ordinary indoor temperature, the grain is chilled by exposure to a temperature a little above freezing point (34°–36° F.) for a period of 10–15 days. Since the temperature is low and the grain not fully swollen, the development of the embryo is so slight that the grain after treatment can be sown in the ordinary way. In fact, it can be dried and stored and sown many weeks later.

The process is known as *vernalisation*, that is, bringing to the spring state. The plants by this treatment are brought into the condition which a winter-sown wheat would have in the spring. The effect of the chilling is *to hasten the occurrence of flowering*. It reduces the length of the non-reproductive, the purely vegetative, part of the life-cycle of the plant. The similarity of this to the photo-periodic effect, with its control of flowering by length of day, is noticeable. We shall see later that the two effects are closely related.

TABLE III

| Variety | Date of ear formation | Days early (−) or late (+) | Comparative yield |
|---|---|---|---|
| Odessa Girka | July 14 | — | 100 |
| *T. erythrospermum* | | | |
| Vernalised | June 5 | − 9 | 111·7 |
| Untreated | July 1 | + 17 | 4·7 |
| *T. ferrugineum* | | | |
| Vernalised | June 12 | − 2 | 141·1 |
| Untreated | July 1 | + 17 | 7·9 |

The effect of vernalisation on two wheats grown at Odessa which are exceptionally late in producing the ear, and so in the ordinary state are useless in the Ukraine, is shown in Table III, where they are compared with a Girka wheat which is

* Continued from p. 934.

especially suited to the local conditions. All were sown on April 11.

Unvernalised, these two wheats were 17 days later in earing than Girka, so that they gave an inconsiderable crop. By vernalisation, both varieties were ahead of the Girka variety in ripening and gave higher yields.

The facts of vernalisation are definite, but, as is the case with photo-periodism, the physiological processes in the plant which are responsible for the phenomena remain for the most part to be discovered. The two phenomena can scarcely be considered separately, for in the absence either of chilling or of the appropriate day-length, flowering may be long delayed or fail altogether. What is to be explained in each case is the manner in which the treatment—chilling or alternation of light and darkness—endows the plant with a potentiality for earlier flowering.

A theory has been put forward by Lysenko which attempts to provide a physiological basis for both the processes. It lays stress on the distinction between vegetative growth and the developmental stages associated with flowering. On this hypothesis the plant must pass through a number of stages before it reaches the stage necessary for flowering. Of these stages two are supposed to be sharply defined, first the heat-stage (thermo-stage) and second, the light-stage (photo-stage), though these stages are not necessarily associated with actual growth. In this view, the external conditions are different for the two stages. For transition through the first stage winter cereals, for example, require a low temperature and a sufficiency of moisture and oxygen to allow of sufficient activity for response of the embryo to the low temperature; illumination is, however, not important. The later light-stage only begins after the completion of the heat-stage; it requires not a low but a moderate temperature, and in the case of the cereals an illumination of more than 10 hours a day, and as an optimum condition, continuous light. With a day shorter than 10 hours this stage cannot be completed and vegetative growth continues indefinitely. In this view, vernalisation by chilling results in the completion of the heat-stage without which the light-stage cannot begin and flowering cannot be achieved; long days then complete the work.

This theory may seem plausible at first sight, but living organisms are so complex that with them, unfortunately, a simple explanation is almost certain to be wrong. At the Imperial College, Gregory and Purvis for some years have been studying the behaviour of the winter cereals in relation both to the vernalisation and the photoperiodic effect. In the first place, it is unlikely on general grounds that such stages should be sharply differentiated—if they do occur one would expect them to merge into one another. In fact, however, the work of Purvis has shown that chilling is not essential for flowering. If winter cereals are grown throughout the winter in the greenhouse, flowering occurs *without chilling* in the lengthening days of spring; there is thus no sharply marked heat-stage.

The weakness of the earlier theoretical considerations of photo-periodism and vernalisation, as has been pointed out by Gregory, lies in concentrating attention on the later and less essential stages of development. In the earlier work on photoperiodism the opening of the flower bud was considered as the test of flowering. The bud, however, is initiated much earlier in the life of the plant, and when regarding the effect of previous external conditions upon flowering, attention would seem most properly to be focused on the stage of initiation of the flowers. This is usually very much earlier than the actual opening of the buds.

Klebs, many years ago, held that the stage of "ripeness to flower" had to be reached before the rudiments of the flowers were laid down, this being followed later by the stage of flower development and of expansion of the floral organs. The photoperiodic effect may be concerned mainly with the last stage. If attention is focused on flower initiation, the morphology of the plant cannot be neglected, as Gregory has insisted. The only plants which have been closely investigated from this morphological point of view are the temperate cereals, rye, barley, wheat, by Purvis at the Imperial College. These, as is well known, have a terminal inflorescence, a certain number of leaves being produced on the main axis before the rudiments of the flowers appear. It has been shown that the number of leaves produced before flowers are formed is dependent upon external conditions. Purvis has demonstrated that the effect of chilling is to reduce the number of leaves formed; thus flower formation begins earlier and so flowering is accelerated. By vernalisation at 1° C. for six weeks the number can be reduced to 13 in rye and recently 9 has been achieved; by very prolonged vernalisation for six months the number in wheat has also been reduced to 9.

It has also been shown that vernalisation is a process which takes place by degrees; even a few days' chilling produces some effect. In an experiment by Gregory and Purvis in which vernalisation was applied to rye for 4, 7, 11, 14, 21, 28, 35, 42 and 49 days, there was some effect at 7 days and the effect was progressive up to 49 days. A further and most suggestive result has been obtained by Gregory and Purvis from these experiments. The number of days of vernalisation added to the number of days between placing the plant under

growing conditions and the opening of the flowers (anthesis) tends to be constant. It would appear then that vernalisation produces no actual acceleration of flowering, since there is no reduction in the time elapsing between the moistening of the grain and the occurrence of flowering. The apparent acceleration is due to the reduction in the number of days in the growing post-vernalisation period.

There is a further interesting point. The number of leaves formed not only responds to chilling but also to length of day. The temperate cereals are described as long-day plants, for their ears emerge in long days. In the winter forms, however, *flower-formation takes place much more rapidly in short days*, while spring forms do not exhibit this need. The effect of chilling winter forms is to make them independent of short days, so that, like the spring forms, they will flower rapidly in long days.

We are still ignorant as to the action of vernalisation by cold. Is it a primary temperature effect on the plant processes, or does the low temperature merely act indirectly by keeping growth in check and so inducing a kind of semi-dormancy in which slow maturation processes go on without any morphological change?

### DARK VERNALISATION

As has been already stated, the sub-tropical cereals, such as maize, sorghum and other millets, are attuned to the short days of the tropics, as are also cotton and the soybean, and have their flowering much delayed in long days. It has been discovered, however, that if the grain of sorghum or millet is kept in darkness for a period, the need for short-day illumination of the plant is removed. The grain must of course be soaked, but in contrast with the vernalisation of winter cereals a high temperature is required. The grain is given about 25 per cent of its weight of water and then kept in the dark for 5–10 days at a temperature of 27°–29° C. After this treatment the plants will flower in long days or even in continuous light; their cultivation can thus be extended to regions of long summer days. This is a considerable achievement and suggests that in such plants the absence of light is necessary for the occurrence of certain changes. What seems to be important is a certain 'dose of darkness'; when a sufficient measure has been given the plant is independent of further periods of night.

Some light has thus been thrown on the nature of photoperiodism and vernalisation by these studies of winter cereals, but the nature of the changes in the plant during the periods of darkness and chilling are still in the greatest obscurity. Two results of general interest, however, have come from these investigations of duckweed and winter cereals. One, the fact that physiological changes, which it is difficult to describe as other than development, can go on in a swollen, 'cold-dormant' seed incapable of growth. Secondly, there has been demonstrated the need for change if the plant is to run its full life-cycle. Duckweed may multiply best at a constant high temperature and continuous light, but for many plants when flowering is concerned, variation in the environment is essential. To them, one may say, uniformity is anathema. It is evident that this need for variety greatly complicates the physiological analysis of plant responses, for the effect of not one but many environments has to be investigated.

# Medical Research in 1935

AS in previous years, perusal of the report of the Medical Research Council* provides the reader with a broad view of the research work carried out in Great Britain in medicine and its allied subjects: from its pages, the trend of recent investigations can be quickly and easily followed. The increase in the grant-in-aid provided by Parliament enabled the Council to restore the cuts in salaries and to proceed with plans for new research work which had been temporarily in abeyance, and to undertake additional investigations required for the purposes of administrative departments. Lord Dawson of Penn and Prof. A. E. Boycott retired from the Council, and Prof. J. A. Ryle and Prof. M. J. Stewart were appointed to succeed them. Towards the close of the period under review, the Council learnt of the impending retirement of its chairman, the Marquess of Linlithgow, on his appointment as Viceroy of India. The funds of the Council have been augmented as in previous years by sums of money for the promotion of particular schemes of research, provided by a number of different bodies. The Council is also responsible for the award of Rockefeller medical fellowships and Dorothy Temple Cross research fellowships in tuberculosis; the arrange-

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1934–1935. (Cmd. 5079.) Pp. 163. (London: H.M. Stationery Office, 1936.) 3s. net.

ment with the Rockefeller Foundation of New York will not, however, be renewed at the end of the present academic year, the fellows who are now abroad being the last to be appointed. The change is not due to any doubts as to the value of the scheme, or to any dissatisfaction with the results which have been achieved; but is due entirely to a fundamental change in policy of the Foundation, which involves abandonment of its present system of international fellowships in favour of concentration upon a more restricted programme for the promotion of research. The Council is concerned with the question of filling the gap in the system of higher medical education caused by the withdrawal of these fellowships; meanwhile, the trustees of the late Viscount Leverhulme are providing funds, for the next five years in the first instance, for the award of one travelling fellowship annually.

The report refers to the practical application of the newer facts of nutrition, and emphasises that, at any rate until recently, the public was unaware of the importance of proper feeding as a factor in preventive medicine. It reviews some of the more practical discoveries which the Council has assisted during the period of its existence. Of these, probably the most important is the discovery and finally the isolation of vitamin D, with the proof of its curative and preventive action in rickets and dental disease. Other investigations have shown the good effects of supplementing the diet of growing children with milk and other substances, and have demonstrated the incidence of nutritional anæmia in pregnant and lactating women and in their infants, and shown how the condition can be avoided or mitigated. Still, even at the present time, only a small fraction of the people have reaped the benefits that modern knowledge of nutrition can offer: the essential teachings can, however, be reduced to a few simple statements. The first is that the younger the child the more essential is correct feeding for proper growth and health: and the second, that much more milk, cheese, butter, eggs and green vegetables ought to be consumed; milk ought to be the chief drink for children, while bread and other cereals should in these early years be greatly reduced.

Among the new substances which have been examined during the past year have been ergometrine, Dakin and West's hæmatopoietic agent (anahæmin) and androsterone. The report reviews briefly the history of the chemistry and pharmacology of ergot; the apparent disparity between pharmacological evidence and clinical practice was not solved until Chassar Moir demonstrated the presence in a watery extract of the drug of a substance stimulating, when given by the mouth, the human puerperal uterus; none of the known constituents of ergot had this effect, and the new alkaloid was finally isolated by Dudley and himself in crystalline form and called ergometrine. The substance prepared from liver by Dakin and West, which has a complex protein structure made up of amino-acid and other groups, has been manufactured in Great Britain, and submitted to clinical trial by Davidson, Wayne and Ungley on cases of pernicious anæmia. The substance thus prepared is extremely potent: injections of from 0·1 gm. to 0·2 gm., once weekly, brought about a large increase in the red blood corpuscles of the patients and in the course of a few weeks restored them to health. Analysis of the death-rates from this disease shows that the therapy has appreciably extended the lives of patients suffering from it.

Viruses and virus-like infective agents have continued to occupy a prominent position in the programme of research at the National Institute for Medical Research. The possibility of obtaining from human cases of epidemic influenza a virus infecting the ferret, and transmissible then to other ferrets and to mice, as mentioned in last year's report, has been abundantly confirmed, although direct transmission from man to mouse has not yet been attained. A certain method of producing complete immunity to the experimental infection has not yet been found, although resistance can be significantly enhanced in either ferrets or mice, by subcutaneous injection of the living virus, which is not infective when thus applied, or of a formolised vaccine prepared from it. A serum neutralising the infective activity of the virus has been prepared by immunising a horse: injections into infected mice have given results which suggest that such a serum might have some value in the treatment of influenzal pneumonia. The virus has been shown to multiply on the chorio-allantoic membrane of the developing chicken and in a saline medium containing fragments of surviving tissue from a chicken embryo. The latter method has also been successfully employed in the cultivation of the viruses of psittacosis, ectromelia, vaccinia and louping ill.

Among other researches which have a close relationship to the public health may be mentioned the work on methods of preventing puerperal sepsis, on industrial pulmonary disease and the toxicity of industrial solvents and on methods of eradicating bed-bug infestation. The use of the new technical procedures which have been developed in recent years for differentiating the hæmolytic streptococci has led to the conclusion that the organisms which are occasionally found in the genital tract of healthy parturient women are not, as was formerly supposed, identical with those causing puerperal fever, and are indeed

usually harmless to their human hosts. The pathogenic types which do invade the genital tract have therefore been conveyed to it from some outside source, for example, the respiratory tract, either of the mother or that of her attendants: familial sources have been incriminated in not a few instances. The results and lessons of that work, if rightly applied, should achieve a reduction in the incidence of hæmolytic streptococcus infection following childbirth.

In conclusion, reference may be made to the work of the Department of Biological Standards at the National Institute for Medical Research. Standards for gas gangrene antitoxins (vibrion septique and *B. œdematiens*), staphylococcus antitoxin and antipneumococcus serum (Types I and II) have been brought into official use under the Therapeutic Substances Act. A new sample of diphtheria antitoxin standard has been prepared. The British standard for pituitary posterior lobe extract has now been adopted formally for international use. The Institute has also accepted responsibility for the preparation and distribution of the international standards for the arsphenamine group of drugs. New standards for a number of other compounds have been adopted for international use and have been distributed, or will be distributed as soon as prepared, namely, insulin, the vitamins (A, C and D) and the sex hormones (œstradiol benzoate, androsterone and progesterone). The supply of progesterone is being undertaken by the Institute: it is being prepared from pregnandiol and stigmasterol, and extracted from the corpora lutea of whales.

# Obituary

## Dr. Arthur Eastwood

ON May 6, after a few hours of illness, Arthur Eastwood, formerly of the Laboratory of the Ministry of Health, died in London in his sixty-ninth year. He was born in Manchester, was educated in its Grammar School and graduated in Lit. Hum. at Oxford in 1893. Deeply read in moral philosophy, with the Bar as the obvious place for his acute intellect and power of lucid exposition, Eastwood at this time fell under the spell of Michael Foster as the 'philosopher in medicine', migrated to Cambridge to sit at Foster's feet and finally qualified M.D. (London) in 1902, after clinical studies at St. Bartholomew's Hospital. His distinguished work in the histology of malignant tumours led the Royal Commission on Tuberculosis to invite him to examine its experimental material. At the Commission's experimental farm in Stansted, Essex, in 1902–9, Eastwood spent seven busy and happy years, making with Cobbett and the brothers Griffith a highly successful 'team', one of the first to show how valuable team-work can be in *ad hoc* research.

The Commission's final report left undecided the question of tubercle bacilli of bovine origin as the cause of tuberculosis in children and, in 1909, Eastwood, at Newsholme's suggestion, was given the post of Inspector to the Local Government Board and asked to establish for the Board its first pathological laboratory, with the duty of investigating this question. The Board's laboratory, later the Laboratory of the Ministry of Health, begun thus as an almost accidental afterthought, developed under Eastwood's direction into a valued branch of the Ministry's medical department. Its activities were recounted and accorded due recognition in the Annual Report of the Chief Medical Officer for 1932. They can be summarised as studies in the bacteriology of epidemics, ranging from bubonic plague (the epizootic in East Anglia in 1910) and cerebrospinal fever (the epidemics of the War years) to pneumococcus and streptococcus infections and directing attention to the significance, practical and theoretical, of serological 'types' in pathogenic bacterial species.

In all these researches Eastwood's clear vision and gift of lucid expression were put at the service of his colleagues. He himself, though, of course, convinced of the prime necessity of experiment in scientific medicine, felt his own true bent to be the philosophical examination of first principles, the synthesis of experimental data into theory and the enunciation of hypotheses worthy of experimental test. A long series of articles, published as Reports to the Ministry or in the *Journal of Hygiene*, was the result. In these, he discussed infection and immunity as parts of the physiology of bacterial cells on one hand and animal hosts on the other. His method was almost Socratic in its simplicity and reliance on pure logic: his articles, whatever may be their ultimate value in advancing knowledge, will continue to delight all who take pleasure in intellectual disquisition. Perhaps the most notable example is his treatment of bacterial variation and transmissible autolysis (Reports on Pub. Health and Med. Subjects, 1923, No. 18) in which he put forward the hypothesis of non-viable mutants as the explanation for the phenomena associated with bacteriophage.

Eastwood's three years of leisure after retirement were devoted to the preparation of a conspectus of immunity in general; he felt that the importance of a unifying hypothesis for the great body of disparate data was not sufficiently appreciated by post-Ehrlich pathologists. It is to be hoped that this had reached a stage permitting of its publication as a final example of Eastwood's method.

# News and Views

### Mme. Joliot-Curie and Scientific Research in France

MME. JOLIOT-CURIE has been appointed Secretary of State for Scientific Research in the new Government just formed in France by M. Blum. Her name will be familiar to scientific readers as that of the daughter of Prof. and Mme. Curie, discoverers of radium, and herself a distinguished worker in the field of artificial radioactivity. M. and Mme. Joliot-Curie have carried out important investigations in various branches of radioactivity which were fittingly crowned by the award to them in 1935 of the Nobel Prize in Chemistry. When the discovery was announced of the positive electron, M. and Mme. Joliot-Curie took up the examination of methods by which it could be produced, and found that positive electrons appeared with neutrons during the disintegration of certain light elements by $\alpha$-rays. It appeared on further investigation that whereas the neutrons were emitted during the $\alpha$-particle bombardment, the positive electrons were due to an entirely separate process, and continued to appear after the bombardment had ceased. The new process thus recognised was then shown to be due to the presence of unstable isotopes with radioactive properties, a discovery which was immediately found to be of wide importance. The preparation and examination of these radioactive bodies of short life period, by investigators in numerous laboratories, have afforded valuable additions to our knowledge of atomic structure and the mechanism of atomic disintegration.

### Dr. C. N. H. Long

DR. C. N. H. LONG, until recently director of the Cox Medical Research Institute in the University of Pennsylvania, has been appointed to the chair of physiological chemistry in Yale University, in succession to the late Prof. L. B. Mendel. This chair was previously held by another famous American physiological chemist, namely, Prof. Chittenden. Dr. Long took a first-class honours degree in chemistry at Manchester in 1921 and then worked in the physiological laboratory there and at University College, London, for a number of years, particularly on matters relating to the physiology and physiological chemistry of muscular activity in man and the higher animals. The work was done on behalf of the Medical Research Council. From University College, he went to McGill University, Montreal, where he was attached to the Medical Unit of Prof. Jonathan Meakins. There he continued his research, and qualified in medicine. From Montreal he went to the Cox Medical Research Institute at Philadelphia, and now he is going to Yale. Dr. Long thus started as a chemist, then became a physiologist, then a professor of research in medicine, and is now going back again to physiological chemistry.

### Mr. W. Dallimore

MR. WILLIAM DALLIMORE retired from the post of keeper of the Museums at the Royal Botanic Gardens, Kew, on March 31, having reached the age-limit after more than forty-five years' connexion with Kew. Mr. Dallimore entered Kew as a student gardener in 1891. He was appointed propagator in the Arboretum in 1892 and assistant curator (at that time called foreman) in 1896. In 1908 he was transferred to the Museums as assistant, and became keeper in 1926. Mr. Dallimore's exceptionally wide knowledge of arboriculture has been of great service to Kew, especially in connexion with the planning and administration of the National Pinetum at Bedgebury, which he will continue to supervise during his retirement. Dr. John Hutchinson, botanist in the Herbarium, has been appointed by the Minister of Agriculture and Fisheries to be keeper of the Museums in succession to Mr. Dallimore.

### Bicentenary of Coulomb (1736-1806)

ON June 14 the bicentenary occurs of the birth of Charles-Augustin de Coulomb, the French military engineer and physicist, who is remembered for his work on friction, machines and electricity and magnetism. Born at Angoulême, he was educated in Paris, and entering the corps of military engineers served successively at Martinique, Rôchefort, the Isle of Aix, Cherbourg and in Paris. He rose to the rank of lieutenant-colonel, was a member of the Royal Academy of Sciences, and after the Revolution, of the National Institute, and was made a chevalier of the Order of St. Louis and a member of the Legion of Honour. He was intimately acquainted with the civil engineering of his day, and his various memoirs were the result of long and refined experiments combined with mathematical inquiries. He counted many eminent men of science among his contemporaries, such as Laplace, Lavoisier, Lalande, Borda, Messier, Monge, Charles, Berthollet and Mechain, but, wrote Thomas Young, "among all the men of science who have done honour to France, it would be difficult to point out a single individual, who, with regard to the cultivation of terrestrial physics, could at all be put in competition with M. Coulomb". Towards the end of his life, Coulomb suffered much from ill-health, and his death took place on August 23, 1806, when he was seventy years of age.

COULOMB'S original investigations fall into two groups, those relating to mechanical subjects and those dealing with electricity and magnetism. It was while he was in Martinique that in 1773 he sent his first paper to the Academy of Sciences. This was on statical problems relating to architecture, and in it he dealt with the strength of blocks of stone, masonry

columns and arches, and embankments. In 1781 he was awarded a prize for his paper on the theory of simple machines, comprehending the effects of friction, and of the stiffness of ropes. He determined the friction between a great variety of substances and applied the results to the study of the launching of ships, ships' capstans and ships' blocks. His "Theoretical and Experimental Researches on the Force of Torsion" was published in 1784, and six years later he dealt with the "Friction of Pivots". Quite early he had turned his attention to magnetism and the compass, and between the years 1785 and 1789 he published seven memoirs on electricity and magnetism. It was in these that he described his well-known torsion balance and enunciated the laws of attraction and repulsion in electricity and magnetism. These memoirs furnished the data on which Poisson later on founded his mathematical theory of electricity. Like many of his contemporaries, Coulomb lost his post in the Revolution, but in the more settled times which followed he became one of the inspectors of public instruction and as such was known for his generosity and kindliness. So far as we know, France possesses no monument to this worthy man.

### "World Fellowship"

ARRANGEMENTS are now approaching completion for the World Congress of Faiths, which from July 3 until July 18 will meet in London to discuss "World Fellowship". The sessions of the Congress, to which only members will be admitted, will take place at University College, Gower Street, W.C.1; but there will also be a series of public meetings at Queen's Hall, Langham Place, W.1, to which the general public will be admitted by tickets, which may be purchased. The main objective of the Congress is to be neither the appraisement of the various religions of the world, nor any attempt to bring about their fusion, but the discussion of ways and means by which the chief religions of the world, each retaining its individuality, may co-operate in a fellowship of the closest unity to eliminate the passions leading to war, economic injustice and racial and religious antagonisms. Communications dealing with various aspects of the problems which arise will be presented in twenty sessions of the Congress by representatives of the Christian, Jewish, Hindu, Buddhist, Moslem and independent faiths. Among those who have promised their co-operation either from the chair, as readers of papers or by opening debate are H.H. the Aga Khan, Sir E. Denison Ross, the Chief Rabbi, Prof. Nicolas Berdaieff, Prof. S. N. Das Gupta, Dr. Cyril Bailey, H. E. Sheikh Al-Maraghi and Sir Abdul Qadir. A paper by the late Prof. J. S. Haldane on "Science and Religion" will be read. Of the public meetings, the first will be a meeting of welcome and the last a retrospect and summation of results, while the remaining two will be devoted to expositions of "The Supreme Spiritual Ideal" as viewed in Jewish, Hindu, Buddhist, Christian, Muslim and independent thought. The international president of the Congress is H.H. the Maharaja Gaekwar of Baroda, and the chairman of the British National Council Sir Francis Younghusband. The members of the Congress will be received by the Marquis of Zetland on behalf of His Majesty's Government at Lancaster House, St. James's, on July 8, and a reception will be given by Sir Francis Younghusband in the garden of the Royal Geographical Society on July 4. Particulars of membership, etc., may be obtained from the Organising Secretary, 17 Bedford Square, London, W.C.1.

### Exhibition of Historic Scientific Apparatus at Cambridge

THE Cambridge Philosophical Society has been responsible for the arrangement of a large and interesting exhibition of historic instruments and records which was opened by Lord Rutherford on June 8 and will be on view until June 20. Acting on the suggestion and with the unstinted help of Dr. R. T. Gunther, of Oxford, an attempt has been made to collect together old apparatus illustrating the work of well-known Cambridge men, as well as some of the equipment used by students of natural knowledge in former days. The collection gives an idea of the material instruments by the aid of which scientific progress has been made in the University, and it establishes contact with the present day by the inclusion of series showing the progress in the design of certain important pieces of apparatus like electrometers, electroscopes, galvanometers, air pumps, slide rules, microscopes and microtomes. Among the pieces of special interest are the fourteenth century astrolabe believed to have belonged to Dr. Caius, a circular slide-rule designed by William Oughtred and made about 1640, Pepys' Musarithmica, the instruments used by W. H. Miller in making the Standard Pound, and the microscopes of Charles Darwin and of his grandfather Erasmus. The remains of the equipment of the observatories of Trinity and St. John's Colleges, and a number of Maxwell's instruments form important features, while the cabinets of materia medica preserved since the early eighteenth century in the libraries of Queens', St. Catherine's and St. John's Colleges are now shown together for the first time. The microscopes used by Francis Maitland Balfour form another exhibit interesting to biologists.

### Population and Production in the U.S.S.R.

PROF. M. POLANYI'S article on "U.S.S.R. Economics", originally printed in "The Manchester School", has now been republished by the Manchester University Press in pamphlet form. This article, which is based on the study of official documents and on observations made by the author during numerous visits to Soviet Russia, gives an interesting account of recent trends besides providing a sketch of the development of the Soviet economy. In dealing with the economic background, Prof. Polanyi points out that the 165 million inhabitants of the U.S.S.R. are sharply divided into a rural and urban population. Of the 40 millions living in the towns, the vast majority are Government employees. They form the basis of its power and are engaged in administration,

banking, trade, industry, the postal, tramway and railway services, teaching, health protection, journalism, science and art. About 125 millions live in villages, and of these about 10 millions are State-paid workers, and their dependants are employed on State-farms or in forestry or fishing.

POPULATION has expanded by 30 per cent since pre-War days, but the production of food has failed to increase in a like proportion. Grain crops during the first five years period fell off owing to internal struggles, but in 1933 and 1934 they increased to about 12 per cent over pre-War production. Grain consumption per head of the population, however, has now reached pre-War level, as export has ceased, whereas in pre-War days about 10 million tons of grain were exported annually. The production of potatoes has increased, but this is offset by a decrease in meat and milk. Housing in both towns and villages is very poor, and as yet little headway has been made. The lack of transport facilities is also very apparent. The European parts of the U.S.S.R. have 1·3 km. of railways per sq. kilometre, whereas in the United States there are 4·3 km. per sq. km., despite the fact that the population density in that part of the U.S.S.R. is 30 per cent greater. The most developed part of the country, namely, the Ukraine, has a density of population nearly equal to that of France, but its railway system is less than one third the length. Moreover, all the railways are in poor condition, and the country is practically roadless.

### Rearmament in Germany

THE question of the extent of Germany's re-armament has recently taken a prominent place in Parliamentary debates and in the public mind, and a number of exaggerated views have been put forward. In one case, for example, it was stated in the House of Commons that no less than £1,500,000,000 had been spent upon warlike preparation during Herr Hitler's regime, and that, in the year 1935 alone, 600–800 millions sterling was spent on armaments in Germany. It is undoubted that Germany has been rearming since 1934, but it is essential that Herr Hitler's programme should be viewed in its true setting and perspective, and to this end Prof. W. A. Bone has prepared a critical examination of the position in Germany based on financial and industrial statistics. This survey, which appeared in *The Nineteenth Century and After* of May, sets out the facts of Germany's industrial activity in the years 1929–35, and shows clearly that the output of those materials upon which armament manufacture chiefly depends—iron and steel, nickel, copper, chromium, tungsten and other non-ferrous metals—merely reflects the slump between 1929 and 1932 followed by the regaining of lost ground to an extent slightly less than that which has taken place in Great Britain. From the analysis given, it is clear that Germany's rearmament, while a factor to be reckoned with, does not account for more than a fraction of the very large monetary sums which have been alleged to be involved.

### Indian Population of North America

UNTIL recently, it would appear that little attention has been given to certain facts relating to the Indian population of North America, which are disclosed in the census returns. It has generally been accepted that the Indian is a dying race; but it is now indicated that, while certain Indian peoples have undoubtedly become extinct, and the Indians of Mexico to a considerable extent have been fused in the general population, the Indian population north of Mexico as a whole is on the up grade. The problem of the future will be, not the arrest of a decrease, but the provision in the reservations of land adequate to support an increased population. This, at least, it is thought at the moment, is the form which the problem will take in the United States. Data relating to the population statistics were examined by Dr. Clark Wissler recently in a communication on the birth-rate among the Plains Indians, which was presented to the American Association of Physical Anthropologists meeting at New Haven, Conn., on April 30–May 2. Dr. Wissler then stated that the birth-rate of the Plains Indians would appear to be the highest in the world, being 48 per thousand. The white birth-rate, even before the depression, had sunk to 20 per thousand. He went on to point out that when the Indian was first placed on reservations, there was a rapid decline in numbers, but this had been checked. This was not due to the birth-rate, which apparently has not changed much since 1800, but arose from a death-rate which reached its peak about 1890 and had since declined.

AN even more marked increase is shown by the figures relating to the Indian population of Canada, where between 1931, the census year, and 1934 when a rough count was made, the numbers rose from 108,000 to 112,000. This high rate of increase is no doubt to be attributed largely to the vigilance in matters of hygiene, exercised by the Department of Indian Affairs, which, it is announced in a communication from the Ottawa correspondent of *The Times* in the issue of June 6, is to become a subordinate branch of the new Ministry of Natural Resources. It is also stated that the trust fund which was created for the benefit of the Indians with whom treaties were made at the time of the acquisition from the Hudson Bay Company of the western territory beyond the Great Lakes, now amounts to 14,000,000 dollars, while between 4,500,000 dollars and 6,000,000 dollars is spent on them annually out of public funds. These Indians live on reservations, and their affairs are managed by chiefs and councillors, who have certain restricted legislative rights. In Ontario and Quebec, however, most of the Indians live the life of ordinary Canadian citizens, being sometimes completely merged in the general population, with farms on the reserves. West of the Great Lakes where two thirds of the Indians live, and they have been less affected by the impact of white civilisation, they are much more dependent on the Government, owing to the

inadequacy of their food supply now that the game, which was formerly their subsistence, has become scarce. Here the Department has embarked on an extensive educational programme in agriculture with a scheme of assistance, for which great success is claimed. Through it some hundreds of Indians have become entirely self-supporting by agriculture within two generations. About one third of the Indians still live the traditional nomadic life in the northern hinterland with the easily moved tepee as their home and hunting and trapping as their means of subsistence.

### Archæological Excavations in Syria

SIR LEONARD WOOLLEY'S account of the first month's work on the British Museum's new archæological site in Syria fully confirms anticipation of the nature of the evidence likely to be obtained at such a point as the mouth of the Orontes, which must have been an important centre of international and commercial intercourse from early times. Tel Sheikh Yusuf el Gharib, a low mound, so called after a local saint, on the right bank of the Orontes, he reports in *The Times* of June 4, has produced evidence of nine occupation levels. As virgin soil has been reached just below deposits which are dated at about the twelfth century B.C., it is evident that the mound begins with what can only be a later extension of the main settlement. Although in consequence no material of Mycenæan age or earlier is forthcoming, it has yielded finds of considerable interest and no little importance. The pottery, for example, includes possibly the finest example of Proto-Corinthian ware yet known, while the so-called 'Cypriote' ware, a class of ceramics appearing in Cyprus in the Early Iron Age without known local antecedents, occurs here rather earlier in the eighth level in such sudden abundance as to suggest a violent occupation, and possibly may eventually afford a clue to the cultural origins of this type in Asia. Especially fine examples of orientalising Ægean wares of the best sorts from the sixth and fifth levels, and innumerable fine fragments of Attic wares, belonging to the late sixth and fifth centuries B.C., some of which can be recognised as by known artists, from the fourth level point, in Sir Leonard's opinion, not only to a flourishing luxury trade with the Ægean, but also to great enterprise on the part of the Athenians in establishing a flourishing commercial centre on this Asiatic coast at a time of tension with the great imperial power of Persia. Evidence was also obtained of intercourse with the Asiatic interior, the occurrence of a basalt bowl, showing a debased Hittite style in decoration, being noted. Such results in a restricted area afford abundant promise from future excavation.

### British Standards Institution

THE annual general meeting of the British Standards Institution was held at the Institution of Mechanical Engineers on June 4, under the chairmanship of Mr. W. Reavell. In reporting on the progress of the work during his year of office, Mr. Reavell made reference to the arbitration in connexion with the standards to be adopted in Great Britain for the 16-mm. sound films which, at the invitation of the General Council, Lord Riverdale had undertaken in February last, and the decision of which is now being loyally adopted throughout the industry. Mention was also made of the forthcoming visit of the director to New York and the Argentine in connexion with the work of the newly formed Argentine Institute for the Rationalisation of Materials. At the luncheon which followed the meeting, Lord Riverdale referred to the very economic manner in which the work is carried out, dealing as it now does with some eight hundred committees and more than a thousand meetings a year. Some people fear that standardisation means stagnation, but this is provided against in the precautions the B.S.I. takes when standards are brought into being and in the frequent review and revision of those standards. Industry does not fully appreciate the value of standardisation in the matter of capital expenditure. It means the possibility of reduction of stocks which in turn means liberating capital, and this might amount to millions of pounds in the British Empire.

MR. E. J. ELFORD, the chairman for the forthcoming year, said that the British Standards Institution is greatly indebted not only to the Government for its continued financial support, to the many technical officers of the various Government departments for their assistance on the technical work, but also to the hundreds of representatives of industry—using that word in the widest sense—who give their time and experience so willingly to this work of growing national importance. Mr. S. Tatchell, chairman of the Building Industries National Council, stressed the great importance to the building industry of the closest co-operation between his Council and the B.S.I., and referred to the agreements recently come to which have been set out in their Report on Standardisation Policy. Colonel Briggs, of Messrs. Unilevers, expressed the satisfaction of the chemical industry at the work already undertaken by the Institution in the chemical field and its desire to co-operate in future work of the Institution.

### The Development Fund

THE twenty-fifth report of the Development Commissioners for the year ending March 1935 has now been published (London: H.M. Stationery Office. 2*s*. 6*d*. net). The function of the Commissioners is to make a thorough examination of applications for grants from the fund, amending or vetoing the schemes submitted if necessary, and afterwards to recommend to the Treasury what advances shall be made. The majority of the schemes aided call for recurrent expenditure, and as advances are made annually the progress of the work is kept under continuous review. Agriculture and rural economy comprise the main bulk of the expenditure, as under this heading come the regular grants to research institutes, advisory centres and rural industries, as well as the special grants, research scholarships and studentships. A short account of each institute is given, describing the type of work undertaken and

the number of staff employed. Under the fisheries section, grants are made towards both 'directed' and 'free' research, as it is recognised that much useful information would be lost if only specified lines of research were encouraged. The Development Fund also makes regular advances towards the construction and improvement of harbours and the acquisition of land for road improvements. The total sum recommended in 1934–35 was £490,968, compared with £343,636 in the preceding year, and the report concludes with a detailed summarised schedule of the expenditure.

### New Electrical Devices

IN *A.E.G. Progress* for the first quarter of 1936, which is published by the foreign department of the Allgemeine Elektricitäts Gesellschaft of Berlin, the company gives its annual general review of novel electrical devices which are being increasingly used in Germany. One of these is an automatic sequence indicator and timer. In ceramic, chemical and food-stuffs industries, many machines are employed to stir or knead the various ingredients. It is often necessary that these materials be added to the mixture in a definite sequence of time. The new indicator consists of a case containing a number of transparent plates, suitably engraved for each process and lighted up from behind in a predetermined sequence. The attendant is thus warned at the right moment without being obliged to watch the clock. A warning bell is sometimes added to the plate lights. For all kinds of mixing operations this indicator gives useful results. Another device is a 'fan heater' used in conjunction with an electric fire. A silent running fan mounted behind the heating elements circulates the hot air without producing any noticeable draught. The room is quickly and evenly warmed and the hot air can be directed to any point where rapid heating is desired. It is stated that the occupants of a room with a fan heater feel a comfortable warmth on all sides. A switch worked by the foot operates as follows. In position 1 the fan runs cold, operating as a ventilator and using as much power as a small lamp (20 watts); in position 2, warm air is emitted, the heater now taking 1,500 watts; and in position 3, it is switched off.

### Mineral Development in Canada

IN a recent series of broadcast addresses, the Minister of Mines at Ottawa emphasised that Canada's vast new mineral wealth is being derived from a line of mining camps extending for 2,400 miles from northern Quebec to Great Bear Lake. Ten years ago, gold production in this belt came from only two districts, whereas to-day mining developments are in progress in a score of separate localities in a region of the Pre-Cambrian shield which is quite unsuitable for agriculture. Thus a new metallic link has been forged between eastern and western Canada which is awakening a new community of interests. The mining camps look to the west for food supplies and to the east for machinery, chemicals, clothing and other factory products. At present the most important section of the new economic frontier is the area including eastern Manitoba, northern Ontario and northern Quebec. Excluding the famous Porcupine, Kirkland Lake and Cobalt centres, the Sudbury nickel-copper district, and the eastern Manitoba gold belt, the oldest of the new mines began production only eight years ago. Now there are twenty-eight new mines, and these have given Canada an additional yearly output of gold and copper worth £7,000,000, a production value more than the annual gold output of Kirkland Lake. The value of the metals produced from this narrow belt alone now exceeds £20,000,000, while that from Sudbury adds a further £12,000,000.

### Physics at Harvard

THE new volume of *Contributions from the Physical Laboratories of Harvard University* consists of reprints of sixty-five papers which have been issued from the laboratories during the years 1933–34. It forms the first volume of Series 2, and its pages are half an inch higher and wider than those of its predecessors. This increase allows papers from double column periodicals like the *Physical Review* and the *Journal of Chemical Physics* to be included without change of form, but papers from the one-column proceedings of the American Academy of Arts and Sciences look insignificant on so large a page. The work represented covers almost every branch of physics—general and atomic physics being the theme of about twenty papers, light and electricity about fifteen each, heat about seven and sound and supersonics three, the classification being approximate only. One paper sketches an interesting course of laboratory work for senior students taking up atomic physics. The subjects which appear most often in the titles are—the effects of high pressures on the physical properties of materials, and the line and band spectra of substances.

### Carnegie Endowment for International Peace

THE annual report for 1935 of the Division of Intercourse and Education of the Carnegie Endowment for International Peace issued over the signature of Dr. N. Murray Butler, the director, gives an impressive picture of work being done both in the United States and in Europe to develop an international mind and outlook, and particularly in regard to collective security. An unofficial international conference was arranged at Chatham House, London, on March 5–7, 1935, to consider what steps might be taken to restore confidence by promotion of trade and reduction of unemployment, stabilisation of national monetary systems and better organisation of the family of nations to give security and to strengthen the foundations of international peace. Through the organisation of meetings throughout the United States, lectures by visiting Carnegie professors and others, the distribution of books and pamphlets, the arrangement of 'international mind' alcoves in libraries, the international relations clubs, the League of Nations Association and in other ways, the Division has sought to make known the unanimous recommendations of the conference and the principles upon which collective security is based.

(*Continued on p.* 989.)

Supplement to "NATURE"

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# Science in a Changing World: Recollections and Reflections*

By Sir Richard Gregory, Bart., F.R.S.

"It only shows what Natur is, Sir," said Mr. Squeers. "She's a rum 'un, is Natur."
"She is a holy thing, Sir," remarked Snawley.
"I believe you," added Mr. Squeers, with a moral sigh. "I should like to know how we should ever get on without her. Natur," said Mr. Squeers, solemnly, "is more easier conceived than described. Oh what a blessed thing, Sir, to be in a state of natur!"

*Nicholas Nickleby*. Chap. xlv.

TWO curious coincidences are associated with the date of this discourse; and I do not think either of them was intentionally arranged by Sir William Bragg or the Managers of the Royal Institution. One is that the centenary of Sir Norman Lockyer's birth will be reached in two days' time, for he was born on May 17, 1836; and the other is that exactly forty-three years ago, on May 16, 1893, I was appointed sub-editor of NATURE. As I took a minor part in Sir Norman Lockyer's work of teaching and research at the Royal College of Science nearly fifty years ago, and was afterwards his assistant in the editing of the journal founded by him in 1869, my reminiscences will be mostly confined to these associations. This, indeed, was what I was asked to do when the honour of giving an address in this historic theatre was extended to me.

It is fortunately possible to associate NATURE with the first announcement of several scientific discoveries of prime importance; and it is to some of these that I propose particularly to refer. Without such a principle to limit and guide me, there would be no more reason for my reminiscences than for those of the editor of any other scientific periodical. It happens, however, that a new era of modern science began about fifty years ago, and that for most of the time I have been engaged in recording its triumphs.

The increase in the number of scientific workers at home and abroad during this period has been very great, and it is reflected in a corresponding increase in the number of original communications contributed to the correspondence columns of NATURE. As an indication of this development, and also of international activities in scientific fields, the following particulars of letters published in the years 1885 and 1935 may be of interest.

| | 1885 | 1935 |
|---|---|---|
| Numbers of letters during the year | 384 | 810 |
| Number of columns | 221 | 787 |
| Average number of letters weekly | 7 | 15 |
| Average number of columns | 4 | 15 |
| Number of countries abroad represented | 24 | 32 |
| Number of scientific centres abroad ,, | 65 | 142 |

It was in the issue of NATURE for September 29, 1892, that Lord Rayleigh first directed attention to his experimental results which showed that nitrogen extracted from chemical compounds is about half per cent lighter than atmospheric nitrogen. In his letter he said:

"I am much puzzled by some recent results as to the density of *nitrogen*, and shall be obliged if any of your chemical readers can offer suggestions as to the cause. According to two methods of preparation I obtain quite distinct values. The relative difference, amounting to about $\frac{1}{1000}$ part, is small in itself; but it lies entirely outside the errors of experiment, and can only be attributed to a variation in the character of the gas."

In March of the following year, Lord Rayleigh described, in a paper read before the Royal Society, the methods and results of experiments having for their object the determination of the absolute densities of air, oxygen, nitrogen and hydrogen; and he then again pointed out that nitrogen prepared from certain chemical substances was decidedly lighter than nitrogen derived from air in the usual manner by the removal of oxygen with heated copper. This difference was the subject of a further paper "On an Anomaly encountered in Determinations of the Density of Nitrogen Gas" read before the Society on April 19, 1894: and Lord Rayleigh then recorded that a globe filled with the lighter nitrogen had been weighed and re-weighed after an interval of eight months but

* From a discourse delivered at the Royal Institution on Friday, May 15.

no change in weight had been found. As is now common knowledge, Sir William Ramsay was afterwards associated with Lord Rayleigh in the inquiry into the nature and cause of the discrepancies observed, and the result of the co-operative research was the paper on argon, "The New Constituent of the Atmosphere", read at a special meeting of the Royal Society, held on January 31, 1895, in the Hall of the University of London, then in Burlington Gardens.

The day after the reading of the paper on argon before the Royal Society, Sir Henry Miers, then Keeper of the Mineral Department of the British Museum (Natural History), directed Ramsay's attention to Hillebrand's observations, made five years earlier, of the frequent presence of what was believed to be nitrogen in the mineral cleveite and other natural uranates. Ramsay was unable to examine the gas obtained by him from cleveite until the middle of March 1895, when he found a new gas which he thought at first was a gas, crypton or krypton, for which he was looking. He sent some of this gas to Sir William Crookes for spectroscopic examination and on the morning of March 24 received from Crookes a telegram saying "Crypton is helium. Come and see it." Four days later the following announcement of this discovery appeared in NATURE.

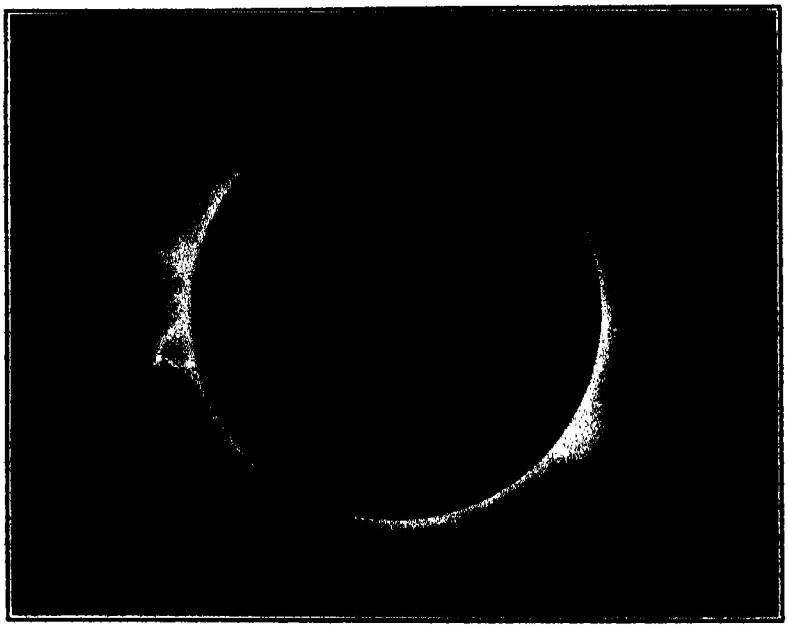


FIG. 1. TOTAL SOLAR ECLIPSE OF MAY 9, 1929, PHOTOGRAPHED BY DR. J. JACKSON AT ALOR STAR. A LARGE PROMINENCE APPEARS ON THE EAST LIMB (LEFT HAND SIDE) OF THE SUN. SUCH PROMINENCES ARE NOW OBSERVED AND PHOTOGRAPHED DAILY IN ORDINARY SUNLIGHT.

TERRESTRIAL HELIUM (?).

We have received the following statement from Prof. Ramsay :—

"I have been trying for clues to compounds of argon. Mr. Miers, of the British Museum, called my attention to Hillebrand's paper on Cleveite, a rare Norwegian mineral, which Hillebrand said gave off 2 per cent. of nitrogen on warming with weak sulphuric acid. Cleveite consists chiefly of uranate of lead, with rare earths. My idea was, if the so-called nitrogen turned out to be argon, to try if uranium could be induced to combine with argon.

"The gas, on sparking with oxygen in presence of soda loses a trace of nitrogen, probably introduced during its extraction ; the residue consists of a mixture of Argon and Helium ! The brilliant yellow line, of which Mr. Crookes makes the wave-length 587·49, is identical with the Helium line. I am collecting the gas, and shall shortly publish regarding its properties."

The identification of helium in terrestrial minerals, twenty-seven years after it had been observed to exist in the sun, is one of the most romantic incidents in the history of science. In November 1866, Sir Norman Lockyer, in the course of a paper read before the Royal Society, suggested that the solar prominences seen around the sun's limb during total eclipses (Fig. 1) might be examined at other times by the use of the spectroscope. As soon as he was in possession of an instrument with sufficient dispersive power, on October 16, 1868, Lockyer found that he was able to observe these solar flames, and that they were local disturbances in the continuous luminous layer which he called the chromosphere. A bright yellow line seen in the spectra of prominences could not, however, be identified with any element then known on the earth. In Lockyer's words : "We had to do with an element which we could not get in our laboratories, and therefore I took upon myself the responsibility of coining the word *helium*."

It must not be supposed that Lockyer hastily came to the conclusion that the strong yellow line seen by him in the spectrum of the chromosphere was due to the presence of an element then unknown on the earth. His chemist friends thought

that the line was due to hydrogen, and it was not until after many experiments had been made to reproduce it in hydrogen that Lockyer came to the conclusion that the line was really due to an element then unknown in terrestrial chemistry.

When Lockyer saw with his spectroscope a solar prominence in ordinary daylight, he believed he was the first to make this observation. The distinguished French astronomer, Dr. Jules Janssen, had, however, seen the bright line two months earlier, on the day after a total solar eclipse which he had been sent to India to observe. The spectroscopic principles which led him to look for the prominences when the sun was not obscured were the same as those stated by Lockyer two years earlier: and they are now used daily to observe and photograph these solar eruptions. By a remarkable coincidence, the communications from Lockyer and Janssen were received by the Paris Academy of Sciences on the same day and within a few minutes of one another. Unlike the discovery of the planet Neptune, which led to bitter controversy over the rival claims of Adams and Leverrier, no question of priority arose between Lockyer and Janssen, and the French Government had a special medal struck in honour of the joint discovery, bearing in profile the portraits of the two astronomers.

It would take a course of several lectures to trace the scientific and practical developments made possible by the isolation of helium. Precise studies of helium spectra in comparison with stellar spectra showed that many lines of which the origins were previously unknown are due to the presence of the new gas. Helium is formed by the disintegration of radium and other radioactive elements, and the alpha particles emitted by them are the nuclei of its atoms. By its use the lowest temperature yet attained on the earth has been reached, and the astonishing phenomenon of supra-conductivity has been studied. It is prepared in immense quantities from natural gas in the United States and is used for many industrial purposes, from the inflation of great airships to the filling of thermionic valves and incandescent filament lamps and arc lamps. For an element first discovered by an astronomer in the sun to prove in time to have so many contacts with pure and applied science is a reward which few investigators can hope to attain.

Early in the year 1896, telegrams from Vienna were published in the daily press reporting that Prof. W. C. Röntgen, of the University of Würzburg, had discovered a new kind of rays, which he called X-rays, which would penetrate many substances opaque to the visible rays of light. He was working with a Crookes' tube covered by a shield of black cardboard when he noticed that a piece of paper coated on one side with barium platino-cyanide became luminescent when an electric current was passed through the tube. This observation was made on November 8, 1895. Following up this discovery, Röntgen made a number of experiments on the properties of these new rays emitted by the Crookes' tube and the resemblances and differences between them and the cathode rays which Crookes, Hertz and Lenard had previously studied.

Prof. Röntgen's paper describing his investigations and the results obtained was communicated to the Würzburg Physical Medical Society towards the end of 1895, and a full translation of it appeared in NATURE of January 23, 1896, and also in the *Electrician* of the following day. In the same issue of NATURE, Mr. A. A. Campbell Swinton told how he had repeated Prof. Röntgen's experiments with complete success, using a Crookes' tube he happened to possess, and with his article was reproduced a shadowgraph of a complete human hand showing the bones distinctly darker than the flesh and muscles surrounding them. This was the first X-ray photograph of a human hand reproduced in Great Britain.

Many other investigators who possessed Crookes' tubes repeated Röntgen's experiments immediately the discovery of X-rays was announced. In the Science Museum, South Kensington, is a tube made for Crookes so long ago as 1879, and used in his laboratory to take an X-ray photograph on January 20, 1896, to test the transparency of various metals in the rays. The keen scientific activity aroused by the publication of Röntgen's discovery may be judged by the fact that between the end of January and the end of June 1896, about 150 papers and other communications dealing with various aspects of the subject were recorded in the columns of NATURE.

Immediately after the announcement of Röntgen's discovery, the Prussian Minister of War caused experiments to be made on its use in army surgery; and it was soon found to be a most valuable aid in the diagnosis of obscure fractures and internal lesions generally. It was also soon noticed that long exposure to the rays resulted in inflammation of the skin. In those early days no precautions against such effects were taken by

radiographers, with the sad result that many pioneer workers suffered serious injury and sometimes death due to working with the rays. It was recently announced that at St. George's Hospital, Hamburg, a stone memorial was unveiled to one hundred and sixty such martyrs of science—medical men, physicists, chemists, laboratory workers, and nurses—and among the names inscribed upon the memorial are those of ten British workers.

For several years before Röntgen observed the fluorescence produced by rays from a Crookes' tube, Sir William Crookes, Sir Herbert Jackson and others had carried out investigations on the phenomena of the fluorescence or phosphorescence of substances in a vacuum under the influence of the electric discharge. Jackson had also noticed that certain substances *outside* the vacuum tubes fluoresced when the current was on, but he was anticipated by Röntgen in finding the explanation of this effect. It was only a few weeks later, on March 5, 1896, that he described in a paper to the Chemical Society an improved form of vacuum tube for producing X-rays and examining their effects. This 'focus' tube contained a concave aluminium cathode and an inclined platinum-iridium anode upon which the rays from the cathode would impinge and produce X-rays. The concave cathode had been used by Crookes, but the mounting of the target or anti-cathode at an angle of forty-five degrees to the axis of the cathode beam was due to Sir Herbert Jackson, and the principle is still used in the Coolidge and other standard forms of X-ray tubes. I remember that, at the time, he was urged by a scientific instrument maker to protect his invention, and if he had done so he would have held the master patent of all such tubes and made a fortune from it. He decided deliberately to leave the device unprotected in order to encourage the scientific study of X-rays and their service to the human race. He thus sacrificed personal profit on the altar of knowledge and manifested a spirit of which the world of science may well be proud.

Modern systems of television depend for their success upon the use of cathode ray oscillograph tubes for the transmission and reception of images; and it is of interest to record that the first suggestion for the application of cathode rays for this purpose was made by Mr. Campbell Swinton in a letter in NATURE of June 18, 1908. At that time success had been achieved in the telegraphic transmission of photographs, and it was thought that distant electric vision was an easy natural step in the development of the process. Thirty years earlier, Profs. Ayrton and Perry worked out a system of television based upon the use of a mosaic of minute sensitive selenium cells, on the lines first suggested by G. R. Carey, but all such plans were impracticable. It was shown by Mr. Shelford Bidwell, who had given much attention to the subject, that on this system of transmitting simultaneously all the rays forming a picture, the number of separate cells, wires and lamps required to obtain a good image on a screen only two inches square, would be no less than 150,000.

Instead, however, of trying to transmit in one moment the enormous number of separate signals required to deal with the various parts of the transmitted picture, the signals may be sent in succession provided that the time taken to scan the picture, and transmit a complete set, does not occupy more than one-tenth of a second. Many attempts were made to solve the problem of distant electric vision on this principle. In Mr. J. L. Baird's early demonstrations of the simultaneous reproduction, at a distance, of images of moving objects, a disk with apertures arranged in a spiral revolved rapidly between the object and photo-electric cells. The varying current thus transmitted modified the light of a neon tube at the receiving end, where a similar disc revolved synchronously with that at the transmitting station. With a sufficiently rapid revolution of the disk, a recognisable image of the object was produced.

To secure satisfactory television by any device involving mechanical movements of this kind, a very intense light source is necessary at the transmitting end, and some method of amplifying the light signals at the receiving end. Experiments with these objects in view are still being carried on and the prospects of success are promising. For the time, however, and especially for home receivers, these mechanical methods have been superseded by methods which are independent of the momentum of the moving parts. This was the principle suggested by Mr. Campbell Swinton in his letter to NATURE twenty-eight years ago. After pointing out that the moving extremities of two beams of cathode rays—one at the transmitting and the other at the receiving end—might be caused to sweep synchronously over the whole required surface, he added:

"Indeed, so far as the receiving apparatus is concerned, the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive

fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.

"The real difficulties lie in devising an efficient transmitter which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the kathode beam of the receiver, and further in making this transmitter sufficiently rapid in its action to respond to the 160,000 variations per second that are necessary as a minimum.

"Possibly no photoelectric phenomenon at present known will provide what is required in this respect, but should something suitable be discovered, distant electric vision will, I think, come within the region of possibility."

It was not until twenty-two years later that Baron von Ardenne in Germany made use of cathode ray oscillograph tubes for the transmission and reception of television images, and gave a public demonstration comparable with that obtained by Baird with his apparatus. Since then many improvements have been made in cathode ray oscillographs, and these, with ingenious mechanical devices, have brought television systems to a remarkable state of perfection.

The principles used are conveniently and instructively shown in apparatus devised for demonstration purposes by Mr. T. E. Bray, of the Baird Television Laboratories (Fig. 2). In this apparatus the intermediate film method is used by which television pictures can be projected to large audiences in cinema theatres and elsewhere. For the direct transmission of television programmes, the principal parts are essentially the same, though some details of the apparatus, particularly at the transmitting end, are different.

In the intermediate film method the scanner is a cathode ray oscillograph the light from which passes through a lens on to an ordinary cinematograph film and then to a photo-electric cell where the light impulses are transformed into equivalent electrical impulses and then amplified. In turn these are received, amplified and excite a cathode ray tube, on the fluorescent end of which the film picture is reproduced. The detail reproduced is a function of the intensity of the light of the scanning lines in the cathode ray tube at the transmitter and of the number of those lines. Though this apparatus illustrates the principles of the use of cathode ray oscillograph in television, actually the light of the oscillograph is not intense enough for transmission. What is used in the Baird system is either the moving spot or the electron camera in conjunction with a fixed light source.

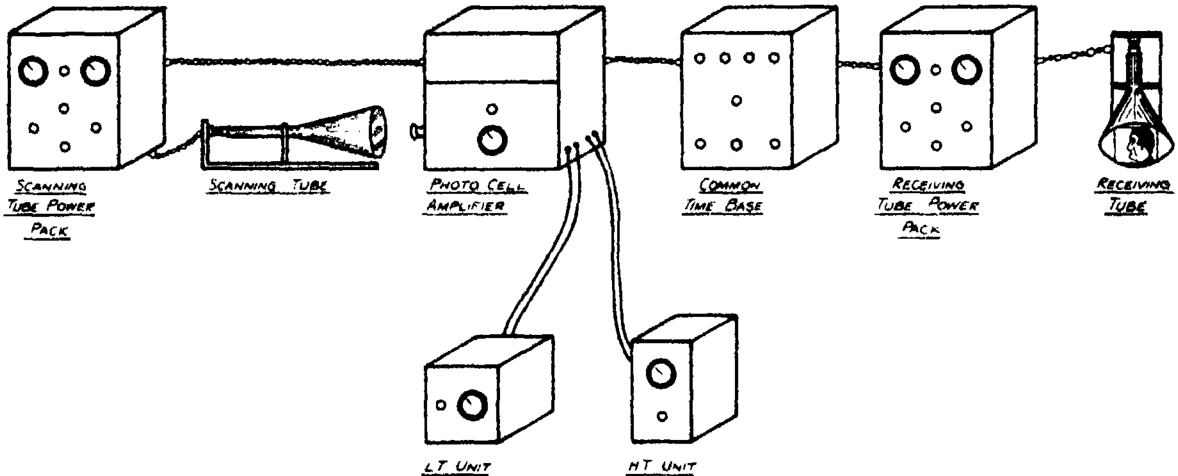



FIG. 2. DEMONSTRATION APPARATUS TO ILLUSTRATE INTERMEDIATE FILM TELEVISION TRANSMISSION AND RECEPTION. (BY COURTESY OF BAIRD TELEVISION, LTD.)

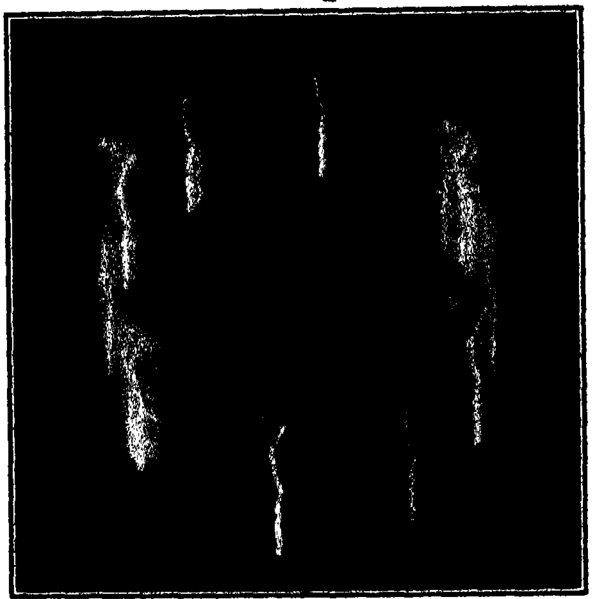
There was a natural transition from cathode and Röntgen rays to Becquerel's discovery in 1896 of penetrating rays from uranium compounds, which laid the foundation of the new science of radioactivity, and to Sir J. J. Thomson's brilliant experimental researches which showed a year later that the cathode rays consisted of swiftly moving particles of small mass carrying a negative charge and constituting electron units of the structure of all atoms. This discovery was itself followed by the isolation of radium by Madame Curie in 1898, and then by the theory, put forward by Rutherford and Soddy in 1903, that radioactive matter is continually undergoing spontaneous transformation of its atoms, the different stages of disintegration being represented by a succession of new radioactive bodies. All these developments have

been fully recorded in scientific periodicals and other publications, and NATURE cannot claim to have been associated with them more closely than any other journal.

Science in a changing world involves, of course, the revision of theories when new evidence is adduced which renders them untenable. Caution in arriving at conclusions is rightly regarded as an essential attribute of the scientific spirit, and it should be accompanied by readiness to acknowledge error. Original communications to a journal or to a scientific society may, therefore, have afterwards to be retracted, because the conclusions reached are found to be based upon imperfect observations. A remarkable example of this occurred in the year 1900. Sir George Stokes had been shown some curious photographs taken at Dover during a thunderstorm. The camera was not pointed in the direction in which the lightning flashes occurred, but the field of view included a number of electric arc lamps used for lighting the town. The photographs seemed to show that, when a discharge occurred, there was a flow of electricity from the lamps to the ground. Sir George Stokes accepted the photographs as evidence of the actual existence of these simultaneous discharges from street lamps at the moments of lightning flashes, and in NATURE of February 8, 1900, there appeared a letter from Mr. Sydney Webb, of Dover, who took the photographs, and a communication from Sir George Stokes, accompanied by reproductions of six pictures and a detailed "explanation of the discharges which took place, simultaneously with lightning flashes in the sky, in the neighbourhood of the electric lamps". The two letters, with the illustrations, occupied more than six columns in the correspondence columns of NATURE. Prof. R. W. Wood was in London at the time, and he pointed out at once that all the effects shown in the photographs, and for which Sir George Stokes had put forward theoretical explanations, were probably due to the camera having been moved during exposure. This proved to have been so. Though the camera was stationary, it was lifted up before the cap was put over the lens, and the trails shown on the photographs were produced during the short interval between lifting and capping. Further photographs with a moving camera confirmed this conclusion, and showed that the effects described and explained were not real.

It happens that in the same year, namely 1900, that these deceptive photographs of secondary effects of lightning discharges were under discussion, Sir Charles Boys designed and made his ingenious camera with the view of obtaining experimental evidence of the progress of a lightning flash. Ten years earlier there had been a controversy as to whether a flash was single or multiple, two or three flashes succeeding one another very rapidly along exactly the same path. To test this point obviously requires a means of obtaining pictures in very quick succession. In Sir Charles Boys's instrument a pair of identical camera lenses is mounted on a disk which can

A



B

FIG. 3. PHOTOGRAPHS OF LIGHTNING OBTAINED WITH A BOYS' CAMERA. *A* AND *B* ARE PHOTOGRAPHS OF THE SAME FLASH; AND THE IMAGES ON THE LEFT AND RIGHT INDICATE DIFFERENCES IN TIME OF DIFFERENT PARTS OF THE FLASH.

be rotated so rapidly that two images of a flash can be obtained at so short an interval as about one forty-thousandth of a second. This apparatus was made in 1900, and Sir Charles Boys carried it about with him to various places in the hope of finding favourable opportunities to use it, but without success. Twenty-six years later, in NATURE of November 20, 1926, he again directed attention to the problem and described the apparatus he had designed to obtain experimental evidence to assist in solving it. Two years afterwards he obtained a photograph of a suitable lightning flash while visiting the Loomis Laboratory, Tuxedo Park, New York. This, with a letter upon it, appeared in NATURE of September 1, 1928; and it showed clearly that, even with the simple instrument used, the method of

oppositely moving lenses was capable of giving two images of a lightning flash definitely different in form.

Improvements of the apparatus were afterwards made; and by the use of a Boys' camera many photographic studies of lightning flashes have been made in South Africa by Dr. E. C. Halliday, Dr. B. F. J. Schonland, Mr. H. Collens and Mr. D. J. Malan (Fig. 3). It has thus been shown that each separate lightning flash begins with a dart-like downward moving tongue of light, which is usually repeated several times until the ground is reached, and is then followed by the main discharge consisting of a return stroke from ground to cloud moving along the thermally ionised track of the leader stroke. Since 1752, when Franklin proved that lightning was an electrical discharge, practically no experimental work on the subject had been done until Sir Charles Boys, who may well be described as the Franklin of our time, devised his revolving lens camera for the study of the propagation of the discharge. That NATURE was given the privilege of making the apparatus and its development known to the scientific world is something to recall with pride.

It may similarly be remembered with satisfaction that, at a time when the possibilities of achieving mechanical flight were either disputed on theoretical grounds or derided by practical men, NATURE gave prominence to all Prof. S. P. Langley's experiments in aerodynamics. Langley began his experiments in 1887, and his work provided precise knowledge as to the resistance offered to planes moving through air at different speeds and inclinations. He communicated a paper on "Experimental Researches on Mechanical Flight" to the Paris Academy of Sciences on July 13, 1891, and a translation of it appeared in NATURE of July 23, 1891. In the course of this paper, Langley said:

"I have been carrying out some researches intimately connected with the subject of mechanical flight, the results of which appear to me to be worthy of attention. They will be published shortly in detail in a memoir. Meanwhile I wish to state the principal conclusions arrived at.

"In this memoir I do not pretend to develop an art of mechanical flight; but I demonstrate that, with motors having the same weights as those actually constructed, we possess at present the necessary force for sustaining, with very rapid motion, heavy bodies in the air; for example, inclined planes more than a thousand times denser than the medium in which they move."

Guided by his results, Langley had model aeroplanes made, or 'aerodromes' as he called them; and he demonstrated in 1896 that mechanical flight was possible by actually performing it with steel flying machines nearly a thousand times heavier than the air, driven by steam, and employing as a rule curved sustaining surfaces. These machines weighed from thirty to forty pounds, and arose and descended in safety, their flight being limited to distances of from half a mile to three-quarters of a mile, at speeds varying from twenty to thirty miles an hour.

Langley's experiments were regarded at the time as the trivial amusements of an astronomer; and when, in 1903, a man-carrying aeroplane designed and constructed by him failed to attain sustained free flight, so much ridicule was thrown upon the trials that he abandoned the subject and devoted himself to other things. The full-size machine was taken out of its shed in 1914, and after a number of changes had been made in it, flights were made with it by a pilot. Much controversy afterwards arose as to whether Langley's original aeroplane of 1903 could ever have been flown, but this question need not be raised again now. A model of this flying machine is in the Science Museum, South Kensington, together with models of aeroplanes made by W. T. Henson and J. Stringfellow about the middle of last century. Whatever opinion may be held as to the capacity of Langley's man-carrying machine to keep in the air under its own power, it cannot be questioned that his experiments with models demonstrated the possibility of mechanical flight at a time when anyone who gave attention to the subject received nothing but derision for his pains, and that NATURE was one of the very few journals in which his experimental work was recorded at every stage.

It would be easy to mention many other instances in which important discoveries and developments have been first announced in the pages of this periodical and in which their significance has been subjected to critical discussion. Consideration of only a few of these belonging to a short period has almost exhausted the opportunity given me of presenting some of my recollections and has filled me with an acute sense of dissatisfaction in the treatment of a theme which might have comprehended advances in many other scientific fields, particularly those of biology and anthropology. For example, in the great advance of knowledge of early man which has followed on the discovery of Piltdown man in

1912, NATURE may fairly claim to have played an important part, both in the announcement of new finds and in the first publication of the scientific description of recent discoveries, such as that of the famous Rhodesian skull found in the Broken Hill mine, and of the Taungs skull, described by Prof. Raymond Dart and named by him *Australopithecus*. All discoveries of this kind, throwing light on the origin of man, always create wide public interest, as do those studies in social sciences which are concerned with the responsibilities of man for controlling his own environment and shaping his own destiny.

Science in a changing world means science adapting itself to the new conditions of life which have resulted from the application of its discoveries; and assisting in the solution of the problems created by them. Though the pursuit of natural knowledge must go forward whatever the consequences, the man of science cannot disregard the social effects of his discoveries. If he creates a Frankenstein monster which becomes the terror of the human race, he may himself end in being shunned by civilised society or his passion for truth be put under control because of the dangers to which it may lead.

The services which science can render to the modern State are now widely recognised, and they are used for evil as well as for good. Forty years ago, the expenditure of the British Government on scientific investigation, as shown in the Civil Estimates, was, excluding expenditure on museums, £45,378; in 1935–36 the total in the Estimates is about £1,300,000, and of this amount the Department of Scientific and Industrial Research is credited with nearly £700,000 for grants for investigation and research and for research establishments. There can be no question that expenditure on scientific and industrial research even on this scale is a profitable national investment, but the greater the extent of such activities, the more urgent is the need to see that they are used to promote progressive human welfare instead of its degradation. Scientific workers have now to pause and consider whether they should be content to let others be responsible for the use or misuse of their contributions to knowledge. When the object of research is the command of natural forces, without regard to their relation to human life, it can become a social danger and an excuse for scientific barbarity. It is the duty of men of science to assist in promoting more worthy uses of the new powers they are continually placing in the hands of the community, for otherwise the world seems likely to be reduced to a place of dust and ashes. The impacts of science with society are now so numerous that scientific studies in the realm of social biology are even more necessary for civilised life than researches in the physical sciences.

It is an ironical comment upon modern civilisation that the social reaction to the gifts of plenty made possible by the progress of scientific knowledge is not a corresponding increase of human welfare but distress and unemployment and the prostitution of scientific effort to purposes of destruction. In so far as science has brought about increased control over the forces of Nature, it accepts responsibility for these conditions. It insists, however, that such deplorable consequences are not essential, but are due to the neglect of the application of scientific methods to the solution of social problems. Our distributive and economic system remains on the basis of a pre-scientific age, wholly unadjusted to the needs of a changing world, and unable to bear the burdens placed upon it by the problem of new and almost incredible abundance.

Science can provide the world with everything required for the maintenance of a growing population in a rising standard of comfort; but there are no accepted principles for the right use of the new powers, and international agreements are mainly adjustments of national interests conceived in confined political atmospheres and determined by expediency. While this spirit prevails, the prospect of finding a formula which will unite civilised peoples for the general well-being of humanity seems almost hopeless. A regenerative influence is required to save civilisation from disaster, and the mission of science in the changing world of to-day should be to introduce it into the field of social biology, and thus enable us still to believe in the highest destiny of man.

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**The Scenery of New Zealand**

NEW ZEALAND has long been careful of State protection of natural features of outstanding value on the grounds both of scientific interest and of scenic beauty. The Annual Report on Scenery Preservation for the year ending March 31, 1935, records additional reserves of 2,027 acres, making a present total of 671,000 acres in 965 reserves. Many of the reserves aim at preserving areas of characteristic vegetation, and it is to be noted that the Native Plants Protection Act came into force in 1935. By this Act, all native plants, except a few species commonly regarded as weeds, are protected throughout the Dominion. There are, however, provisions for taking plants in reasonable numbers for scientific study or medicinal purposes. The larger reserves seem to have paid wardens, but many of the smaller ones are cared for by honorary inspectors.

**Announcements**

THE Brazilian Government has recently founded an international centre for the study of leprosy at Rio de Janeiro.

THE fifteenth Japanese Congress of Physiology will be held next August at the Ohara Institute of Kurashihi, Oyama, and will last three days.

THE International Federation of Eugenic Societies will hold a congress on July 16–21 at Scheveningen and The Hague. Further information can be obtained from the vice-president, Dr. Georges Schreiber, Avenue du Recteur Poincaré 26, Paris XVI$^e$.

THE Institute for Investigation of the Brain, at Leningrad, which contains 180 cerebral hemispheres of adults, 300 of children and 470 of lower animals, is engaged in the preparation of a microscopical atlas of the cerebral hemispheres of man and the lower animals. It is also occupied with the study of the brains of the most eminent representatives of science, art and politics.

THE first International Conference on Fever Therapy will be held at Columbia University, New York City on September 29–October 3, its aim being to collect and crystallise data connected with fever induced by physical or other agencies as a therapeutic procedure. The subscription is 15 dollars. Further information can be obtained from the secretary, Dr. William Bierman, 471 Park Avenue, New York City.

DR. HELLMUT DE TERRA informs us that a mistake has been made in the first column of the table accompanying his article "Late Cenozoic History in India" in NATURE of April 25, p. 686. The Upper Pleistocene period covers the stages of column 2 named Redeposited silt, Erosion and *Potwar*; the Middle Pleistocene covers the stages named Erosion and *Boulder Conglomerate*; the Lower Pleistocene covers the stages named *Pinjaur* and *Tatrot*. The broken line indicating an unconformity which appears between the Boulder Conglomerate and the Pinjaur should extend across the column to the left between "Middle" and "Lower".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of electrical engineering in the Newton Heath Branch Technical School—The Director of Education, Education Offices, Deansgate, Manchester, 3 (June 15).

A teacher of chemistry and mathematics in the North-Western Polytechnic, Prince of Wales Road, Kentish Town, London, N.W.5—The Secretary (June 17).

A teacher of mechanical engineering in the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Clifton Road, Rugby (June 18).

A lecturer in charge of the Department of Civil Engineering in the University of Sheffield—The Registrar (June 18).

A lecturer in biochemistry and a lecturer in physiology in the University of Leeds—The Registrar (June 19).

A scientific officer (*A*.4) for research in chemical problems, a scientific officer (*A*.40) for research in strength of aircraft structures and materials, an assistant (Grade I, *A*.48) for research in aeronautical electrical equipment, and assistants (Grade III, *A*.58/83) for tests in the Aerodynamics Department, of the Air Ministry Scientific Research Pool for service at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (June 19).

A head of the Department of Electrical Engineering in the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (June 20).

A teacher of mathematics and a teacher of technical drawing in the Wandsworth Technical Institute, London, S.W.18—The Secretary (June 22).

A lecturer and an assistant lecturer in engineering (civil or municipal) in University College, London, W.C.1—The Secretary (June 25).

An assistant (Grade II) in the Admiralty Scientific and Technical Pools (physics or electrical engineering) —The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (June 26).

A scientific officer for research on internal combustion engines at the Royal Aircraft Establishment, South Farnborough, Hants (Royal Aircraft Scientific Research Pool)—The Chief Superintendent (June 26).

An assistant lecturer in physics in University College, Southampton—The Registrar (June 30).

A chemist in a War Department at Woolwich—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (June 30).

A technical officer in the Meteorological Office—The Secretary (S. 2. e.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (July 3).

A chief mechanical engineer at the Royal Naval Cordite Factory, Halton Heath, Dorset—The Secretary of the Admiralty (C.E. Branch), London, S.W.1.

An assistant lecturer in geology and geography in King's College, Strand, London, W.C.2—The Secretary.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 998.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Sensitivity of Insects to Sound

IN the course of experiments directed to another end, we have had occasion to determine the sensitivity at different stimulus frequencies of certain structures in the cricket (*Gryllus domesticus*) and the locust (*Locusta migratoria migratorioides*). These structures are (*a*) the long hair-sensilla on the *cercus* of the cricket, recently shown to subserve a partially acoustic function[1], (*b*) the tympanal organ of the locust and (*c*) receptor organs which we believe to be identical with the short hair-sensilla generally distributed over the body of the locust.

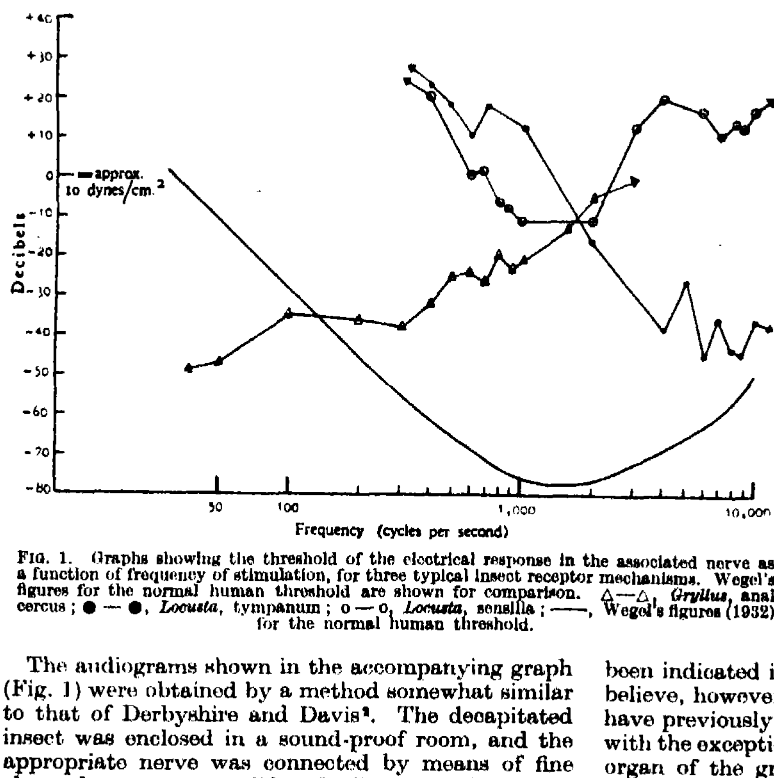


FIG. 1. Graphs showing the threshold of the electrical response in the associated nerve as a function of frequency of stimulation, for three typical insect receptor mechanisms. Wegel's figures for the normal human threshold are shown for comparison. △—△, *Gryllus*, anal cercus; ● — ●, *Locusta*, tympanum; o — o, *Locusta*, sensilla; ——, Wegel's figures (1932) for the normal human threshold.

The audiograms shown in the accompanying graph (Fig. 1) were obtained by a method somewhat similar to that of Derbyshire and Davis[2]. The decapitated insect was enclosed in a sound-proof room, and the appropriate nerve was connected by means of fine electrodes to an amplifier feeding a cathode ray oscillograph and loudspeaker, so that the activity in the nerve could be made to give both a visible and an audible sign of its occurrence. The acoustic organ was stimulated by pure tones from a loudspeaker fed from a beat oscillator and amplifier. The output from the former could be varied over a frequency range of 50–10,000 cycles per second, and could be attenuated by 130 db. in 2 db. steps below a maximum of about 100 microwatts per sq. cm. at the point of stimulation. This stimulator was previously calibrated with sufficient accuracy for our purpose by reference to five 'normal' ears. Waveform and frequency monitoring was carried out with a cathode ray oscillograph, the time-controlled 50-cycle A.C. mains forming the primary frequency standard. The threshold of the organ under investigation at any given frequency was taken to be that intensity which produced a just perceptible activity in the associated nerve. The records of two observers were found to agree within $\pm 2$ db.

In Fig. 1 the threshold intensities of representative animals have been plotted in decibels above and below a sound pressure of 10 dynes per sq. cm., and, in order to emphasise the relatively high sensitivity of two of the groups of receptors at the two extremes of the human auditory spectrum, the readings on the five human observers, reduced to Wegel's classical figures[3], have been plotted on the same graph. The curves clearly indicate that the significance of a sound to these insects cannot possibly be judged by its apparent loudness to the human ear; a response from the cercus may be readily elicited by a low-frequency stimulus quite inaudible to man, whilst the slope of the curve for the tympanal organ appears to show that its sensitivity would very greatly exceed that of the human ear at frequencies above 10,000 c.p.s., the present limit of our apparatus.

The presence of scattered receptors sensitive to sound at quite low intensities in an insect which is also provided with a specialised acoustic organ is a matter of some interest, though their existence has been indicated in insects of certain other orders. We believe, however, that no quantitative measurements have previously been made on any of these receptors, with the exception of those of Wever[4] on the tympanal organ of the grasshopper. These are in fair agreement with ours on the similar organ of the locust.

R. J. PUMPHREY.
A. F. RAWDON-SMITH.

Laboratories of Zoology
and Psychology,
Cambridge.

[1] R. J. Pumphrey and A. F. Rawdon-Smith, *J. Physiol.*, **86** (1936). (*Proc. Physiol. Soc.*, March 14, 1936.)
[2] A. J. Derbyshire and H. Davis, *Amer. J. Physiol.*, **113**, 2, 476 (1935).
[3] R. L. Wegel, *Ann. Otol.*, **41**, 770 (1932).
[4] E. G. Wever, *J. Comp. Psychol.*, **20**, 17 (1935).

**A Simple Relation between the Quantities $e$, $c$ and $h$**

IF $e$ is the negative electron charge, which reckoned in C.G.S. is $4 \cdot 7755 \times 10^{-10}$ of an electrostatic unit, and if $c$ is the velocity of light *in vacuo* ($2 \cdot 9986 \times 10^{10}$ cm./sec.) and $h$ is Planck's Constant of Action which is $6 \cdot 55 \times 10^{-27}$ erg-seconds, then, as is well known, the quantity $hc/2\pi e^2$ is a pure numeric generally given as equal to 137, or perhaps, 137·3.

If we absorb the $2\pi$ we can express the relation of $e$, $c$ and $h$ as follows: The quantity $e^2 = 22 \cdot 805 \times 10^{-20}$ is of the dimensions of energy multiplied by length or erg-centimetres. The quantity $h$ (which I venture to name 1 acton) is of the dimensions of energy multiplied by time or erg-seconds. Hence the quantity $e^2/h$ is of the dimensions of a velocity and is equal to $22 \cdot 805 \times 10^7 \div 6 \cdot 55 = 34 \cdot 82 \times 10^6$ cm./sec. Also the velocity of light, $c$, is $29{,}986 \times 10^6$ cm./sec. and $29{,}986 \div 34 \cdot 82 = 861$. But the number 861 is the product of three prime numbers, namely, 3, 7 and 41, the first, third and twelfth primes—omitting to count 1 and 2 as primes.

Also 861 is a triangular number of the form $n(n+1)/2$ or $(41 \times 42)/2$, and in addition it is the sum of the natural integers $1 + 2 + 3 +$ etc. up to 41. A triangular number denotes the number of equidistant dots which can be arranged in an equilateral triangle, namely, 3, 6, 10, 15, 21, etc. Also approximately $\pi = 3\frac{1}{7}$.

Hence we can write the equation

$$\begin{aligned}\frac{h \times c}{e^2} &= 3 \times 7 \times 41 = 861\,;\\ &= 3 \times 7 \times 37 + 3 \times 7 \times (3+1)\,;\\ &= (3\tfrac{1}{7} + 3\tfrac{1}{7})\ 137.\end{aligned}$$

The numbers 1, 3 and 7 are trinal numbers of the form $n^2 + n + 1$, where $n$ is given values of 0, 1 or 2. The velocity represented by $e^2/h$ is nearly 1/861 of that of light *in vacuo*.

AMBROSE FLEMING.

"Greenfield", Manor Road,
Sidmouth, S. Devon.

## Electrodynamics of Macroscopic Fields in Supraconductors

THE conception of a 'pure supraconducting state' has proved to be useful for the description of those phenomena of supraconductivity in which no phase transitions into the non-supraconducting state are implicated. In the pure supraconducting state the supraconductor shows no macroscopic electromagnetic field ($E = 0$, $B = 0$). It has been shown[1] that this state can be described by a consistent theory in which the idea of an infinite conductivity is replaced by the conception that, by a general relation, the supracurrents are connected with the magnetic field. The latter penetrates into the supraconductor only as deep as the supracurrents flow.

On the basis of this theory of the pure supraconducting state, a magnetostatics of the so-called 'intermediate state' has recently been developed[2] of which the characteristic feature is the appearance of a macroscopic magnetic induction $B$. In the intermediate state, the supraconductor is imagined as consisting of many separated microscopic pure supraconducting elementary regions, in an analogous way to the elementary regions of spontaneous magnetisation in a ferromagnet. The free energy density $f$ of such an intermediate state has been calculated as a function of the magnetic induction, and it has been found, for $|B| \leqslant H_T$, where $H_T$ is the magnetic threshold value, that

$$f = -\tfrac{1}{8}H_T^2 + H_T\,|B| \quad . \quad . \quad . \quad (1)$$

A generalisation of this theory is wanted for the case where an *electric* field is also present. While the general case still presents some difficulties, a very elementary conception can be developed for the special case, in which:

($a$) the direction of the electric field $E$ is everywhere perpendicular to the magnetic induction $B$ and parallel to the macroscopic current $J$;

($b$) the actual surface energy of the supraconducting state appreciably exceeds the lower limit derived from thermodynamics[3].

Possibly the result that follows has a more general validity than can be ascertained at present.

From ($b$) one can infer that the dimensions of the supraconducting regions into which the supraconductor as a whole splits up are big compared with the depth to which the magnetic field can penetrate into these regions, and that therefore all macroscopic fields are chiefly due to the normally conducting inclusions. Then to a first approximation we are justified in neglecting all 'penetration' effects and may simply set the microscopic magnetic field equal to 0 in the pure supraconducting regions (whereas the microscopic electric field vanishes there exactly). The normally conducting regions may be assumed to have the form of gaps with nearly equidistant boundaries; they will, according to ($a$), contain the electric field orientated perpendicular to the boundaries and the magnetic field parallel to them.

Let $e$ and $h$ be the microscopic field strength in such a gap, and let $\xi$ be the volume of the gaps per unit volume of the supraconductor; then the macroscopic $E$ and $B$ are given by

$$E = \xi e \quad \text{and} \quad B = \xi h \quad . \quad . \quad . \quad (2)$$

On the boundary between the two phases the Maxwell pressure $\frac{1}{8}(h^2 - e^2)$ will be in equilibrium with the pressure $\frac{1}{8}H_T^2$ due to the free energy of transition into the supraconducting state (which amounts to $-\frac{1}{8}H_T^2$ per unit volume):

$$\tfrac{1}{8}(h^2 - e^2) = \tfrac{1}{8}H_T^2 \quad . \quad . \quad . \quad . \quad (3)$$

or introducing the macroscopic quantities (2) into (3), we obtain the following equation, which determines $\xi$:

$$\xi = \frac{\sqrt{B^2 - E^2}}{H_T} \quad . \quad . \quad . \quad . \quad (4)$$

The free energy $f$ per unit volume consists of two parts:

(i) the 'electromagnetic energy' $f_1$ localised in the normally conducting gaps:

$$f_1 = \xi\,\tfrac{1}{8}\,(h^2 + e^2).$$

(ii) the 'internal free energy' $f_2$ of the pure supraconducting part, which comprises a fraction $1 - \xi$ of the total volume:

$$f_2 = (1 - \xi)\,.\,(-\tfrac{1}{8}H_T^2).$$

For the total free energy $f = f_1 + f_2$ we obtain, using (2) and (4):

$$f = H_T \frac{B^2}{\sqrt{B^2 - E^2}} - \tfrac{1}{2} H_T^2, \quad . \quad . \qquad (5)$$

which is valid for $0 \leqslant B^2 - E^2 \leqslant H_T^2$ or $\xi \leqslant 1$.

This expression is a generalisation of formula (1) obtained for the pure magnetostatic case. It can be derived from a Lagrangian

$$\mathrm{L}(E, B) = H_T \sqrt{B^2 - E^2} - \tfrac{1}{2} H_T^2, \quad . \quad . \ (6)$$

which is connected with the free energy $f$ by the well-known relation

$$f = \mathrm{L} - E \frac{\partial \mathrm{L}}{\partial E}.$$

By its derivatives, L defines the quantities $D$ and $H$ as functions of $B$ and $E$:

$$\left.\begin{aligned} D &= -\frac{\partial \mathrm{L}}{\partial E} = \frac{E}{\sqrt{B^2 - E^2}} H_T \\ H &= \frac{\partial \mathrm{L}}{\partial B} = \frac{B}{\sqrt{B^2 - E^2}} H_T \end{aligned}\right\} \quad . \quad . \qquad (7)$$

As to the connexion between the macroscopic current density $J$ and the field, an independent statement is still required. In the normally conducting regions $e$ will be accompanied by a current $j$ according to Ohm's law:

$$j = \sigma e,$$

where $\sigma$ is the conductivity of the normal phase. This current is to be continued into the supraconducting regions without an accompanying electric field. The component of the macroscopic current $J$ parallel to $E$ will therefore be given by

$$J = \sigma e = \frac{\sigma E}{\sqrt{B^2 - E^2}} H_T = \sigma D \quad . \quad . \qquad (8)$$

Finally, we assume the macroscopic Maxwell equations and the customary boundary conditions: $H_{tg}$, $B_n$, $E_{tg}$, $D_n + J_n$ continuous.

Though this reasoning cannot, of course, claim to be more than a first and quite provisional attempt, and hysteresis and other disturbing effects will certainly complicate the real state of affairs appreciably, it seems that on the basis of the equations communicated above a consistent theory can be built up. Formally it may be considered as a kind of limiting or degenerate case of the Born–Infeld field theory. There a Lagrangian of the form $a^2\sqrt{1 + b^{-2}(B^2 - E^2)}$ or $a^2\sqrt{1 + b^{-2}\,(B^2 - E^2) + b^{-4}\,(B\,E)^2}$ with $a = b$ forms the basis; the Lagrangian (6) corresponds to the limiting case $b \to 0$, $a^2/b = H_T$.

I have succeeded in applying this theory to the phase transition in a supraconducting wire caused by the magnetic field of a current through the wire, and to other problems which I hope to discuss *in extenso* elsewhere.

F. LONDON.

Clarendon Laboratory,
Oxford.
May 26.

[1] F. and H. London, *Proc. Roy. Soc.*, A, **149**, 71 (1935); *Physica*, **2**, 341 (1935). M. v. Laue, F. und H. London, *Z. Phys.*, **96**, 539 (1935). F. London, *Proc. Roy. Soc.*, A, **152**, 25 (1935). E. Schrödinger, NATURE, **137**, 824 (1936). H. London, *Proc. Roy. Soc.*, A, **155**, 102 (1936)

[2] F. London, *Physica*, **3** (in the press).

[3] C. J. Gorter, *Physica*, **2**, 449 (1935). H. London, *Proc. Roy. Soc.* A, **152**, 650 (1935).

## Nebular Spectra due to Elements of the Second Period

MEASUREMENTS of the hot spark spectrum of sulphur in the Schumann region have enabled me to classify partially the singlet system of S III and to locate the new terms with respect to the known triplet system by means of numerous intercombinations. It has been possible to find two singlet terms in K VI from Ekefors'[1] data and to locate them with respect to the known triplets by intercombinations. The new terms are listed in Table I.

Table I

| S III | | K VI | |
|---|---|---|---|
| $s^2p^2\ ^3P_0$ | 0·00 | $s^2p^2\ ^3P_0$ | 0·00 |
| $^3P_1$ | 297·2 | $^3P_1$ | 1,131 |
| $^3P_2$ | 832·5 | $^3P_2$ | 2,927 |
| $s^2p^2\ ^1D_2$ | 11,320 | $s^2p^2\ ^1D_2$ | 18,973 |
| $s^2p^2\ ^1S_0$ | 27,163 | | |
| $s\,p^3\ ^1P_1$ | 136,839 | $s\,p^3\ ^1P_1$ | 223,840 |
| $4s\ \ ^1P_1$ | 148,898 | | |
| $5s\ \ ^1P_1$ | 211,327 | | |

The isoelectronic sequences from Si I for the forbidden transitions which might be expected in nebulæ obey the irregular doublet law very accurately. Interpolated values for the 'nebular pair' in Ar V (ground $^3P_1$, $^3P_2 - {}^1D_2$) accurate to a few cm.$^{-1}$ may be found. Table II lists the computed wave-lengths for these forbidden transitions together with the name commonly assigned them.

Table II

| Element | Nebular pair ($3p\ ^3P_{1,2} - 3p\ ^1D_2$) | Transauroral line ($3p\ ^3P_1 - 3p\ ^1S_0$) | Auroral line ($3p\ ^1D_2 - 3p\ ^1S_0$) |
|---|---|---|---|
| S III | 9535<br>9069 | 3721·1 | 6310·2 |
| Ar V | 7008<br>6436·5 | 2694 ± 65 | 4610 ± 50 |
| K VI | 6229<br>5603 | 2375 ± 65 | 4097 ± 75 |

Lists of unknown spectrum lines found in nebulæ or novæ have been published by Swings[2] and amended by Stoy[3]. In those lists we find λλ 6311, 6435 and 7007 A. These lines have all been very tentatively proposed as being due to Ar V. Prof. Bowen suggested to me last summer as a result of my data on P II that the first line might be the auroral line of S III. These data now confirm this and show, as well, that the last two lines form the nebular pair of Ar V. The S III transauroral transition, if present, coincides with $H_\mu$. The K VI nebular pair correspond to no lines in Swings' list. The two unknown lines, 4571·5 and 4064, are possibilities for the auroral transition in Ar V and K VI respectively, but if either one can be thus correctly identified, the other cannot be considered.

HOWARD ADDISON ROBINSON
(Irving Langmuir Fellow,
American Scandinavian Foundation).

Physical Institute,
University of Uppsala.

[1] Ekefors, Inaugural Dissertation. Uppsala, 1931.

[2] Swings, Act. Scien. et Indus., 241; Exp. d'Astron. Stel V. Les Spectres des Neb. Gaz. Hermann et Cie, Paris, 1935.

[3] Stoy, Lick Obs. Bull., 480, Dec. 1935.

## Quantum Energy of γ-Rays Excited by Slow Neutrons

IN the course of investigation on γ-rays excited by neutrons, we have recently determined the absorption curves of the secondary electrons due to γ-rays emitted from 24 elements, namely, H, Al, Cl, K, Ti, Cr, Mn, Fe, Ni, Co, Cu, Zn, As, Se, Br, Y, Ag, Cd, Sb, I, Sm, W, Au and Hg, under the bombardment of slow neutrons, by means of the method of coincidence of two counters. The form of the curves obtained differs considerably from element to element,

and the ratio of the half-value thickness to the maximum range of the electrons is by no means a constant for different elements, indicating the inappropriateness of the use of the former as the measure of γ-ray energy. The difference in the form of absorption curves should, of course, be understood to be due to the different heterogeneity of γ-rays.

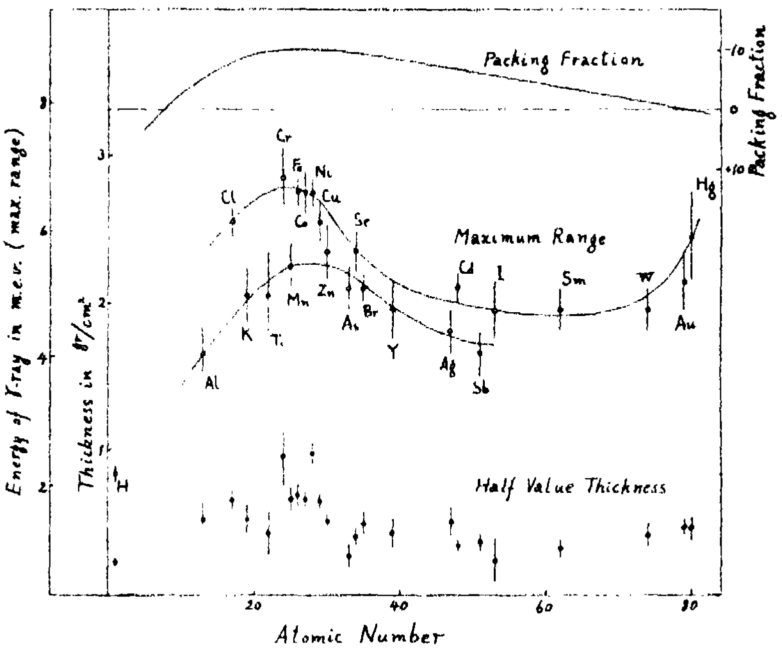


FIG. 1.

The energies of the hardest γ-rays obtained from the end points of the absorption curves are plotted in Fig. 1 against atomic number. The vertical lines attached to the points indicate the estimated errors. It is shown clearly that the points are distributed along two smooth curves, which are nearly parallel to each other, both of which have maxima at the atomic number near 26. On account of the scarcity of data for elements of higher atomic number, the behaviour of the curves in this region is not yet clear. But the tendency to rise again after attaining the minimum values near atomic number 65 cannot be overlooked. It is also quite noticeable that the elements belonging to the lower curve are mostly odd in atomic number, while those belonging to the upper one are mostly even.

For comparison, the packing fraction curve taken from Aston's data is plotted in the same figure. We notice at once the striking coincidence in the position of the maxima of these curves. The general form in other parts of the curves differs considerably; in particular, the probable existence of a minimum in the case of γ-rays cannot be recognised in the packing fraction curve.

We believe that these results may offer important information as to the structure of a nucleus, the atomic number of which is not too small.

A detailed communication on these and allied subjects will appear in the *Proc. Phys. Math. Soc. Japan* shortly, as the fourth of our series of reports on the excitation of γ-rays by neutrons.

SEISHI KIKUCHI.
KODI HUSIMI.
HIROO AOKI.

Physical Institute,
Osaka Imperial University.
April 8.

### Variation in Latitude with the Moon's Position

IN an earlier communication to NATURE[1] brief results were presented on an investigation of small residuals in the latitude of three of the international latitude stations based on observations made in the years 1909, 1910, 1911. It was there pointed out that there appeared to be a lunar diurnal variation in latitude with a range amounting to so much as 0·07″, depending upon the hour angle and declination of the moon.

There has just come to my hand a paper by Mr. Kawasaki on "Variation in Latitude with the Moon's Position"[2]. From data contained in the last report of the International Latitude Service, vol. 7, covering the years 1922.7 to 1931.0, Mr. Kawasaki finds a lunar semi-diurnal variation for Mizusawa of $0{\cdot}011''\cos(2t - 349°)$, where $t$ is the hour angle of the moon. Comparable values are found for the stations Carloforte and Ukiah.

Mr. Kawasaki also expresses surprise at not finding so large results as those of my earlier investigations and particularly that the lunar diurnal variation is small. He followed nearly, although not quite, the procedure I have used in the treatment of such observations. In place of dividing his data into three groups corresponding to declinations, + 12° to + 28°, − 12° to + 12°, − 12° to − 28°, he makes only two groups, 0° to + 28°, 0° to − 28°. By so doing, he has lowered the mean declination for observations both north and south of the equator, thus tending to minimise the effect of changing declination in the results. He allows for the Chandlerian motion, including also such annual terms as presumably exist, by taking for the residuals of latitude the difference between the observed value for a given night and a mean curve which he has drawn through the mean observed values of latitude for each month.

In my treatment of the observations for discovering such a lunar effect as may exist, the day by day values were plotted for the three-year period 1909, 1910, 1911. The running means of these values of latitude and the corresponding dates were taken for five successive nights continuously through the series. A smooth curve was then drawn through the points representing the running means, and the variations of the latitude from this smooth curve were considered with respect to the moon's position. If, as Mr. Kawasaki states, the reversing in phase of the curves with declination of the moon is an annual effect, it would seem that such an annual effect would have come out from the smooth curve covering the daily values extending through the three-year period.

It so happened that prior to the receipt of Mr. Kawasaki's paper, I had just finished a similar analysis as before presented covering the years 1928–31 from data contained in the last report of the International Latitude Service, vol. 7. The variation obtained for these three years, which appears to correlate with the moon's position from my own results, I have found to be less than half of that previously obtained, although approximately the same

amount of data has been treated in precisely the same way. It would appear that such variations as may correlate with the moon are more apparent during some years than others. There is also some indication that there is a change of phase with lapse of time, so that the more years that are included in a single investigation for this effect the smaller is the resulting value.

An investigation by Mr. Kimura, appearing in the same number of the *Proceedings* as Mr. Kawasaki's paper, directs attention to the fact that if the declinations of the stars used in vol. 7 of the International Latitude Service are to be adjusted from the measures of latitude therein contained, a correction of $+0 \cdot 11''$ is needed. While the addition of this amount to all the declinations necessarily increases the mean latitude of all the stations, Mr. Kimura finds the surprising fact that Mizusawa has apparently shifted south by so much as $0 \cdot 12''$ when the results of vol. 7 were compared with the results of vol. 5.

It does not seem improbable that geophysical changes may be taking place which confuse the problem. In view of this, it would seem desirable to restrict investigations for these small variations of the moon's position to intervals of not more than three years at a time. Intercomparisons of the investigations of these relatively short periods may lead to further light on the question.

In this connexion it should be mentioned that in the latest report of the Association de Géodésie de l'Union Géodésique et Géophysique Internationale, Dr. Walter D. Lambert has directed attention to the fact that Schumann published in 1906[3] an investigation in which he found a large lunar term in latitude of the order of $0 \cdot 03''$, which depended on the moon's hour angle and not twice the hour angle. Schumann's earlier work would appear reasonably consistent with my findings from investigations of observations for the years 1909, 1910, 1911, and for Gaithersburg in 1913 and 1914[4].

HARLAN T. STETSON.

Cambridge, Massachusetts.
April 3.

[1] NATURE, 131, 437 (1933).
[2] *Proc. Imp. Acad., Tokyo*, 11, No. 10 (1935).
[3] Ergänzungshefte zu den Astronomischen Nachrichten No. 11.
[4] NATURE, 123, 127 (1929).

## Number of Ions produced in Dielectric Liquids by Cosmic Rays

THE electrical conductivity of liquid dielectrics in their normal state depends to a great degree on their purity. By a very careful purification, the conductivity of some liquids of this type can be lowered to about $10^{-19}\ \Omega^{-1}\ \text{cm.}^{-1}$.

It is significant that a further reduction of conductivity cannot be obtained by means of any of the known methods of purification. Investigations on the conduction of electricity through liquid dielectrics show the existence of a close analogy between the properties of these liquids and those of ionised gases[1]. The residual conductivity may be attributed to (1) impurities which cannot be removed, (2) a small conductivity of the character proper to metals or semi-conductors, (3) lowering of the barrier of potential on the surfaces of metallic electrodes under the influence of the contact with liquids[2], (4) ionising action of cosmic rays. It may be noted that the ionising action of cosmic ray bursts in liquid dielectrics was studied recently by Prof. C. Białobrzeski and the author[3].

The purpose of this note is to show that the cosmic rays are responsible for the conductivity observed. The calculations are based on the results of my measurements with hexane ($C_6H_{14}$) filling a multiple parallel plate condenser. The volume of the liquid was 810 c.c. and the surface of the electrodes collecting the ions was 540 cm.$^2$. From the value of the saturation current, namely, to $10^{-16}$ amp./cm.$^2$, it follows that the number of pairs of ions produced 420 cm.$^3$ sec.$^{-1}$.

If we suppose that the amount of ionisation by cosmic rays is proportional to the number of electrons in a given substance, we can easily calculate that the above number corresponds to $0 \cdot 7$ pair of ions per cubic centimetre per second in air at N.T.P. Taking the number of cosmic ray particles as given by Millikan to be $1 \cdot 48 \pm 0 \cdot 055$ cm.$^{-2}$ min.$^{-1}$, the ionising power of a cosmic ray particle amounts to $1 \cdot 7 \times 10^4$ pairs of ions per cm. in hexane, which corresponds to $28 \cdot 6$ ion pairs in air at normal conditions. This is rather smaller but of the same order as the number of ions produced by cosmic rays or obtained by various authors[4]. It therefore seems reasonable to conclude that the limit of conductivity of liquid dielectrics is nearly reached, and that the residual conductivity is due mainly to ionising action of cosmic rays.

The above remarks concern only the penetrating components of cosmic radiations, $A$ and $C$, according to the scheme of Geiger-Fünfer[5]; the secondary soft radiations, $D$ and $E$, produced by the hard radiations in the metal parts of the apparatus can be responsible only for surface effects appearing at the electrodes.

I. ADAMCZEWSKI.

Institute of Theoretical Physics,
Joseph Piłsudski University,
Warsaw. April 20.

[1] I. Adamczewski, *Acta Physica Polonica*, 3, 235 (1934).
[2] A. Nikuradse, "Das flüssige Dielektrikum". (Berlin: Springer, 1934.)
[3] C. Białobrzeski and I. Adamczewski, NATURE, 136, 109 (1935).
[4] I. Adamczewski, loc. cit.
[5] H. Geiger, "Ergebnisse der exakten Naturwissenschaften", 14, 1935.

## Electrical Changes in Interfacial Films

DURING the course of an investigation of the ionic permeability of *thin* non-aqueous films, some interesting observations were made in regard to the electrical conductance of the films.

FIG. 1. Oscillograms on single bubble films of carbon tetrachloride. Ordinates: Input potential (parallel with the conductance). Abscissæ: Time axis (to be read from the left, total duration about 1 second). Left-hand figure: 50 mv. D.C. in the bubble circuit. Right-hand figure: constant A.C., 1,000 cycles, in the bubble circuit.

The arrangement was in principle as follows: Thin films of the non-aqueous liquids were formed using a technique somewhat similar to the blowing of a soap bubble, the inside and outside air being replaced by aqueous electrolyte solutions in which

non-polarisable electrodes were immersed. The electrodes were connected through a suitable amplifier to a cathode ray oscillograph. In the input circuit was included a high value of grid leak and a D.C. potentiometer or an A.C. oscillator. Occasionally, in place of the potentiometer two different solutions were employed, giving rise to a diffusion or phase boundary potential.

As the bubble film became thinner, it was observed in the case of several liquids (such as carbon tetrachloride, olive oil) that *the D.C. conductance changed abruptly from a barely detectable value to a measurable one, and continued to increase in definite steps* until the bubble eventually burst. In the same instances the A.C. conductance varied, but this was more continuous. The oscillograms reproduced (Fig. 1) will illustrate this behaviour. $0 \cdot 1 \, N$ KCl was used on both sides of the film.

In other cases, for example, using nitrobenzene, in spite of symmetrical leads and the absence of any current polarisation, it was noted that an 'asymmetry potential' was developed, changing in a characteristic manner as the interfacial non-aqueous film became thinner.

A more detailed account of these observations and of other electrical phenomena in interfacial films of this type will be given elsewhere.

TORSTEN TEORELL.

Department of Medical Chemistry,
University, Uppsala.
April 15.

## Oxidation of Single Crystals of Zinc Sulphide studied by Electron Diffraction

CRYSTALS of sphalerite were heated in air until covered by a thin film showing interference colours. These crystals were photographed in an electron diffraction camera, which will be described elsewhere. The angle between the incident beam and the crystal face was very small. The wave-length was 0·053 A. (calibrated from a powder photograph of MgO and a transmission photograph of $MoS_2$). The distance between the crystal edge and the photographic plate was 303·5 mm. Figs. 1, 2 and 3 represent the diffraction patterns in three different cases. In Figs. 1 and 2 the oxidised face was (111), and the incident beam was perpendicular (Fig. 1) and parallel (Fig. 2) to the octahedron edge. By photographing along two different octahedron edges the same pattern was obtained. In Fig. 3 the oxidised face was (110), and the incident beam was perpendicular to the cleavage edge [001]. *This direction is in fact parallel to an octahedron edge.* The diffraction patterns are all of the transmission type, on which is superposed a faint powder photograph. They form a series of photographs such as would be expected if we had photographed a single crystal structure in different directions, the crystal having for each direction of the incident beam the form and dimensions necessary for obtaining a point pattern.

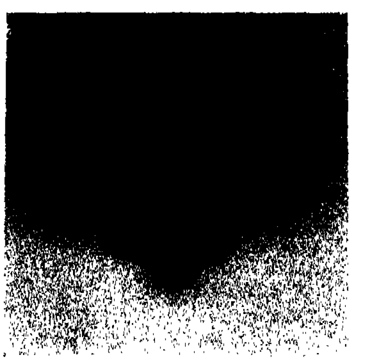

FIG. 1.

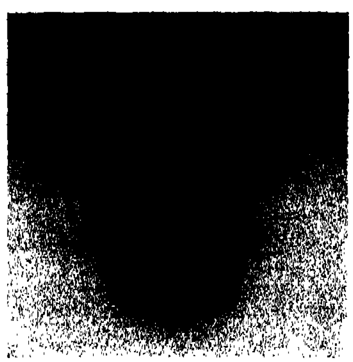

FIG. 2.

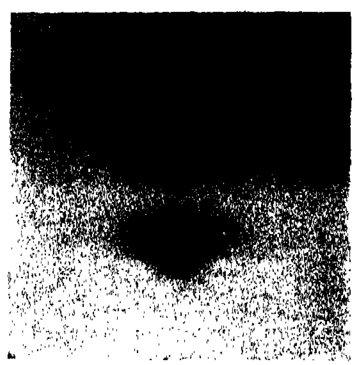

FIG. 3.

The structure which has given rise to these point patterns is hexagonal and is so orientated that the $c$-axis is perpendicular to the octahedron face and the $a$-edge parallel to the octahedron edge. The same position in relation to the ZnS structure is observed on the cleavage plane (110), where the hexagonal $c$-axis should make an angle of 35° 16′ with the normal to the plane (110) (compare Fig. 3, which actually shows the same pattern as Fig. 2, but inclined to it at 35°). The dimensions are: $a = 3 \cdot 30$ A., $c = 5 \cdot 27$ A., $c/a = 1 \cdot 60$. For chemical reasons we assume the film photographed to consist of zinc oxide (ZnO). The dimensions of ordinary zinc oxide[1] ($a = 3 \cdot 24$ A., $c = 5 \cdot 19$ A., $c/a = 1 \cdot 60$) are, as a matter of fact, very near to those observed.

Assuming the structure to be ZnO, we observe that forbidden reflections (for example, $(000l)$ in odd orders) occur in Figs. 2 and 3 (along the hexagonal $a$-axis). On photographs perpendicular to the octahedron edge, on the other hand, no forbidden reflections occur (Fig. 1). A discussion proves that these observations cannot be explained by assuming an *aggregate of crystallites in slightly different positions* (superposition of several planes of the reciprocal lattice). The assumption of 'repeated reflections'[2], however, can explain the presence of the forbidden reflections in Fig. 2 and is not incompatible with the absence of forbidden reflections in Fig. 1. This assumption seems to be the only one capable of explaining the striking fact that certain forbidden reflections are present in one type of photographs but absent in the other (odd orders of $(000l)$).

It should be observed that in all the photographs (*from different crystals*) typical point patterns appear. There is consequently no reason to suppose that this is due to a few isolated small crystals, which are by chance hit by the incident beam. On the contrary, it seems necessary to assume that everywhere in the film the conditions requisite for the appearance of a point pattern exist.

G. AMINOFF.
B. BROOMÉ.

Swedish Museum of Natural History,
Mineralogical Department,
Stockholm.
April 15.

[1] C. W. Bunn, *Proc. Phys. Soc. London*, 47, 835 (1935).

[2] Compare H. Raether's application of Bethe's theory in *Z. Phys.*, 78, 536 (1932).

## Synthetic Œstrogenic Agents without the Phenanthrene Nucleus

THE preparation and physiological properties of synthetic œstrogenic agents were first described in these columns and elsewhere[1,2,3]. The active compounds described in these publications were derivatives of phenanthrene or 1 : 2 : 5 : 6-dibenzanthracene, and it was noted that at the time of writing no active substances had been discovered which did not contain the phenanthrene nucleus.

Subsequent work has been directed towards an attempt to discover which portions of the molecule were responsible for the œstrogenic activity. It has been found that the phenanthrene condensed-ring structure is not necessary for this activity, and the accompanying table gives a number of these substances together with a measure of their activity.

| Substance | Dose in mgm. | Percentage positive |
|---|---|---|
| 1 : 2-Dihydroxy-1 : 2-di-α-naphthyl-acenaphthene | 100 | 100* |
| ,, ,, ,, | 10 | 100 |
| 1 : 1-Di-α-naphthyl acenaphthenone | 100 | 100 |
| α-Naphthyl benzoin | 100 | 40 |
| Diphenyl-α-naphthyl glycol | 100 | 60 |
| Diphenyl-α-naphthyl carbinol | 100 | 100 |
| 4-4-Dihydroxydiphenyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) dimethyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) methyl ethyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) methyl propyl methane | 100 | 100 |
| Di-(4-Hydroxy-3-methyl phenyl) di methyl methane | 100 | 100 |
| Di-(4-Hydroxy-3-methyl phenyl)-1 : 1-cyclo-hexane | 100 | 100 |
| 2 : 4-Dihydroxy-triphenyl methane carboxylic acid lactone | 100 | 100 |
| 4 : 4[1]-Dihydroxy benzophenone | 100 | 60 |
| 4 : 4[1]-Dihydroxy diphenyl | 100 | 100 |

* Rats remained in œstrus 40 days.

The technique of testing the activity of these substances is that described in previous communications[4]. In every test, five ovariectomised rats were used. The weighed dose was dissolved or suspended in 3 c.c. of sesame oil and given in six separate injections of 0·5 c.c., morning and evening on three successive days. Vaginal smears were examined twice daily until the œstrus change disappeared. Only full cornification and complete absence of leucocytes was regarded as a positive œstrus response.

Other derivatives of diphenyl and diphenyl methane have been tested, but up to the present only those containing two hydroxyl groups in the para positions have been found to be active. It is premature to discuss the significance of these experiments, and further work on these lines is proceeding.

We wish to thank Dr. F. L. Pyman, of Boots Pure Drug Co. Ltd., Nottingham, for providing samples of the substituted di(hydroxy-phenyl)-methanes.

E. C. DODDS.
WILFRID LAWSON.

Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W.1.

[1] Cook, Dodds and Hewett, NATURE, 131, 56 (1933).
[2] Cook and Dodds, NATURE, 131, 205 (1933).
[3] Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc.*, B, 114, 272 (1934).
[4] Allan, Dickens and Dodds, *J. Physiol.*, 68, 348 (1930).

## Echinenone as a Provitamin A

THE pigment echinenone was recently isolated by one of us from the sexual glands of the sea urchin *Echinus esculentus*[1]. The glands from 400 urchins were first extracted with acetone. The extracted pigments were then separated into hydrocarbon and xanthophyll fractions by partition between petroleum ether and 90 per cent methyl alcohol. The echinenone was contained in the former solvent both before and after saponification, and was separated from β-carotene by the chromatogram method. The new pigment was absorbed as a dark violet layer in the upper part of the column of slaked lime. After extraction, 4 mgm. of dark violet needles with a metallic lustre (m.p. 192°-193°) were obtained. In carbon disulphide solution a broad band with three ill-defined maxima at 520, 488 and 450 mμ was shown; in alcohol these bands were even less pronounced. From the spectroscopic properties and elementary analysis ($C_{40}H_{58}O$) ($\pm H_2$) it would appear probable that echinenone is a mono-ketone occupying an intermediate position between β-carotene and semi-β-carotene.

A specimen of the pigment, after a preliminary separation from carotene by adsorption on aluminium oxide, was purified by two further adsorptions on the same adsorbent, two adsorptions on slaked lime, two recrystallisations from benzene and ethyl alcohol mixture, one from petrol ether and alcohol, and finally once more from benzene and alcohol. This specimen was sent to Cambridge, and was examined for biological activity as a provitamin A. Rapid restoration in growth was observed in rats restricted to a diet deficient in vitamin A when daily doses of 5γ or 10γ of the pigment were given; a temporary slow resumption of growth was observed with 2·5 γ. The administration of about 4 mgm. of the pigment, spread over several days, to a rat already cured by small doses, resulted in the appearance in the liver of an amount of vitamin A equivalent to 400 blue units (roughly 0·1 mgm. of the 'pure' vitamin). Only traces (30 y.u.) of yellow pigment were present. The band at 630 mμ characteristic of the blue colour given by vitamin A with antimony trichloride was clearly observed.

From this evidence it is clear that echinenone may function as a provitamin A. The degree of activity is apparently of the same order as that of the carotene isomers, although the tests carried out were insufficiently extensive to decide whether the activity approximated more closely to that of β-carotene, or, as might be expected from the presence of only one β-ionone ring system, to that of the presumably somewhat less active α-form. It may be worthy of note that echinenone, apart from β-carotene which is found in both plants and animals, is the first animal carotenoid found to possess vitamin A activity.

E. LEDERER.
Institut de Biologie Physico-Chimique,
Paris.
T. MOORE.
Nutritional Laboratory, Cambridge.

[1] Lederer, *C.R. Acad. Sci.*, 201, 300 (1935).

## Production of Attached *X*-Chromosomes in *Drosophila melanogaster* Males

KAUFMANN[1] and Neuhaus[2,3] indicated the likelihood of crossing-over between *X*- and *Y*-chromosomes in females of *Drosophila melanogaster*. They explained the frequent attachment of the long arm of the *Y*-chromosome to the proximal end of the *X*-chromo-

some as described by Stern[4], as a result of crossing-over in males between the $X$- and the short arm of the $Y$-chromosome.

To verify the above, I undertook the following experiments: males, having the gene forked and either the short or the long arm of the $Y$-chromosome attached to the proximal end of the $X$-chromosome, were mated to *yy* females. If crossing-over between $X$- and $Y$-chromosomes in males takes place when the $X$-chromosome is divided into two strands, then it may be possible to obtain forked females with attached $X$'s.

The experiments gave the following results: the males forked $XY$ short produced 44,240 flies, and among those there were found 26 forked females with attached $X$'s. The males forked $XY$ long yielded 43,852 flies among which only one forked female with attached $X$'s was found. Males without any part of $Y$-chromosome attached produced about 100,000 flies, among which no females with attached $X$'s were obtained.

These results indicate that crossing-over in males between $X$ and the short arm of the $Y$-chromosome occurs much more frequently than with the long one and that this crossing-over takes place between chromatids.

Further experiments are in progress.

M. J. NEUHAUS.

Maxim Gorky Medico-Genetical
Research Institute,
Moscow, U.S.S.R.

[1] R. P. Kaufmann, *Proc. Nat. Acad. Sci.*, 19 (1933).
[2] M. I. Neuhaus, *C.R.*, 3, No. 1 (1935).
[3] M. I. Neuhaus, *Z. Ind. Abst. und Vererbgsl.*, 71 (1936).
[4] C. Stern, *Z. Ind. Abst. und Vererbgsl.*, 51 (1929).

## The 'Photosynthetic Unit' in the Assimilation Process of Green Plants

IN connexion with the recent letter of Henry I. Kohn[1] on the 'photosynthetic unit', I should like to point out briefly the result of a discussion given in a paper which was communicated by Prof. F. G. Donnan to the *Journal of General Physiology* early in April of this year.

An explanation of the fact that the plant can accumulate the four quanta necessary to reduce one molecule of carbon dioxide with practically no loss of energy may be found in the peculiar structure of the chloroplast and in the state of the chlorophyll in the living plastids. According to the investigations of Liebaldt[2] and Mencke[3], the chloroplast consists of a lipoid phase, in which the chlorophyll is dissolved, which is itself dispersed in an aqueous 'hydroid phase'.

It seems that the chlorophyll has to fulfil two different functions, depending on its situation in the chloroplast. The chlorophyll molecules on the surface of the lipoid phase (in contact with an aqueous phase) combine with carbon dioxide to form a light-absorbing chlorophyll carbon dioxide complex, and in this way take part in the reduction of the carbon dioxide.

The greater part of the chlorophyll molecules is dissolved in the interior of the lipoid phase and absorbs the energy of the light, which is then stored in the form of electronic excitation energy. It is well known that electronic excitation energy is practically never directly transferred into kinetic energy (heat)[4]; therefore the quanta absorbed in the interior of the lipoid phase will be handed over from one chlorophyll molecule to another by a sort of resonance effect, and eventually reach the chlorophyll molecules on the surface. In this way all the energy absorbed in the interior can ultimately be used for the assimilation process on the surface. This process implies that the chlorophyll molecules in the lipoid phase are in a state of strong mutual interaction. The observed shift of the absorption maximum of chlorophyll in the living plastids by 150–200 A. towards the red region as compared with chlorophyll in solution or in the colloidal state[5] may be due to interaction forces of this kind.

It is also possible to explain Kautsky's observation[6] that strongly assimilating leaves show a considerably weaker fluorescence than in the normal state. In the case of non-assimilating leaves, the energy coming from the interior of the lipoid phase is not captured on the surface and is eventually given up as fluorescent light.

On the basis of these arguments, the 'photosynthetic unit' of Emerson and Arnold is determined by the ratio

$$\frac{\text{(active) chlorophyll in the surface}}{\text{chlorophyll dissolved in the interior of the lipoid phase.}}$$

The obvious implication is that for every chlorophyll molecule on the surface (actively reducing carbon dioxide) there are about 500 molecules in the interior which provide it with the necessary quanta.

In conclusion, I should like to thank Prof. F. G. Donnan for his continuous help and interest.

JOSEPH WEISS.

Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College,
London, W.C.1.

[1] H. I. Kohn, NATURE, 137, 706 (1936).
[2] E. Liebaldt, *Z. Botanik*, 5 (1913).
[3] W. Mencke, *Protoplasma*, 21, 279 (1934).
[4] cf. J. Franck und H. Levi, *Z. phys. Chem.*, B, 27, 409 (1935).
[5] B. Hubert, *Rec. trav. botan. néerland*, 32, 364 (1935).
[6] H. Kautsky und A. Hirsch, *Naturwiss.*, 19, 964 (1931).

## Acetylation of Agar

IN view of the recent publication by N. W. Pirie[1] on the acetolysis of agar, it seems advisable to communicate preliminary results from this laboratory, where an investigation on the structure of agar has been proceeding.

Pirie states that agar is difficult to acetylate in comparison with many other polysaccharides. This does not appear to be the case, however, when suitably prepared agar is treated with pyridine and acetic anhydride, as chloroform-soluble agar acetates are formed, the acetyl content of which varies, with the duration of the time of acetylation, from 36 to 43 per cent (as $CH_3CO$). Deacetylation regenerates agar indistinguishable from the original in its ability to form a gel, and no apparent degradation has therefore occurred during the acetylation process. When a chloroform solution of the acetate is allowed to evaporate, a tough colourless film is obtained.

The low specific rotation of these acetates in chloroform solution ($[\alpha]_D^{18}$ c. $-30°$) may be connected with the presence of β-linkages in the molecule, since the hydrolysis of agar gives rise to a solution of positive rotation ($[\alpha]_D^{18}$ c. $+30°$).

Experiments on the hydrolysis of agar indicate that the reducing power of the solution after hydrolysis is not wholly accounted for by the presence of

*d*-galactose together with the as yet unidentified reducing acid first described by Lüdtke[2]. The *l*-galactose isolated by Pirie accounts to some extent for this discrepancy. Much further work, however, appears to be necessary before even a tentative structure can be proposed for the polysaccharide, and stress must be laid on the necessity of securing a homogeneous starting material.

E. G. V. PERCIVAL.
W. S. SIM.

Chemistry Department,
The University,
Edinburgh.
April 28.

[1] Pirie, *Biochem. J.*, **30**, 369 (1936).
[2] Lüdtke, *Biochem. Z.*, **212**, 419 (1929).

## Diamagnetic Susceptibility of Heavy Water

SINCE our communication in NATURE of April 25 (p. 706), we have repeated the determination of the mass susceptibility of deuterium oxide using two specimens of purity 99·95 per cent. Our mean result now obtained is $0·638 \times 10^{-6}$, which agrees excellently with our previous value, obtained with a slightly less pure specimen, and also with the value obtained by Cabrera. This therefore may be taken to establish the value of the mass susceptibility of deuterium oxide at ordinary temperature at the figure named.

V. C. G. TREW.
JAMES F. SPENCER.

Bedford College,
London.
May 22.

# Points from Foregoing Letters

THE sensitivity to sound of different frequencies shown by certain organs of the cricket (the long hair-sensilla on the cercus) and of the locust (tympanal organ and receptor organs distributed over the body) has been determined by Dr. R. J. Pumphrey and A. F. Rawdon-Smith and found to be in some respects more extensive than the human. In particular, the sensitivity of the anal cercus appears greater than the human for the lowest audible frequencies, whilst there are indications that the tympanal organ possesses superhuman sensitivity at the opposite end of the spectrum.

Sir Ambrose Fleming discusses various numerical characteristics of the number 861, obtained by dividing the product *hc* (action quantum and velocity of light) by the square of the electronic charge ($e^2$).

An extension of the supraconductivity theory devised for the 'intermediate' state, in which supraconductors are imagined as consisting of many separated microscopic elementary regions, is given by Dr. F. London, to make it applicable to a case where an electric field is also present (with certain restrictive assumptions). Dr. London states that he has met with success in applying the theory to a phase transition brought about in a supraconducting wire by the magnetic field of a current through the wire.

By means of new ultra-violet data, the singlet systems of S III and K VI are partially classified by Dr. H. A. Robinson. These data show that S III is present in nebulæ and, by interpolation, confirm the presence of Ar V.

The quantum energy of γ-rays emitted from twenty-four elements under the bombardment of slow neutrons has been determined by S. Kikuchi, K. Husimi and H. Aoki; they find a striking correlation between energy of γ-rays and atomic number of element bombarded.

Prof. H. T. Stetson, from an analysis of latitude observations for the years 1928–31, finds variations in latitudes with the moon's position amounting to less than half those previously calculated for the 1909–11 period. He also discusses the considerably lower results obtained by Kawasaki for the period 1922–31 and suggests that latitude variations correlating with the moon's position are more apparent during certain years; further, that the problem may be complicated by change of phase and by geophysical movements. He concludes that periods of analysis should not exceed three years.

Assuming that the residual electrical conductivity of hexane, which cannot be decreased by any known method of purification, is due to ionisation by cosmic rays, and taking the number of cosmic rays as given by Millikan to be 1·48 cm.$^{-2}$ min.$^{-1}$, Dr. I. Adamczewski calculates that the ionising power of a cosmic ray in hexane corresponds to 28·6 ion pairs in air at normal conditions, which is of the right order of magnitude.

The electrical conductivity across thin films of non-aqueous liquids (carbon tetrachloride, olive oil, etc.) changes abruptly as the film becomes thinner from a barely detectible to a measurable value, in a step-wise manner, according to experiments by Prof. T. Teorell.

When a single crystal of zinc sulphide is heated in air, it is covered by a film of zinc oxide. This film, when examined by electron diffraction, shows the properties of a single crystal in a crystallographically defined position relative to the ZnS-structure, according to Prof. G. Aminoff and B. Broomé.

A table giving the œstrogenic properties of a number of organic compounds together with a rough indication of their activity is given by Prof. E. C. Dodds and W. Lawson. Of various diphenyl methane derivatives tested, only those containing two hydroxyl groups in the *para* positions have been found to be active; the presence of a phenanthrene condensed ring is not necessary for this sex-hormone activity.

The carotenoid pigment echinenone, recently isolated by Dr. E. Lederer from the sexual glands of the sea urchin, *Echinus esculentus*, has been tested by Dr. T. Moore for activity as a provitamin A, with positive results.

Experiments described by M. J. Neuhaus indicate that, in male fruit flies, crossing-over between the *X*-chromosome and the short arm of the *Y*-chromosome occurs more frequently than with the long arm of the *Y*-chromosome, and that the crossing-over takes place between chromatids.

To explain the process of carbon assimilation by green plants (photosynthesis), Dr. J. Weiss assumes that for every chlorophyll molecule which reduces carbon dioxide at the surface of the fat-soluble (lipoid) particles in the chlorophyll granule, there are about 500 chlorophyll molecules in the interior of the granule, which provide the surface molecule with the four necessary quanta of energy.

# Research Items

### Essex Periwinkles

MR. F. S. WRIGHT has carried on an investigation of the periwinkle *Littorina littorea* in the River Blackwater estuary ("Report on the Maldon (Essex) Periwinkle Fishery". *Fish. Invest.*, Series 11, 14, No. 6, 1936. Ministry of Agriculture and Fisheries). The main point in question was to ascertain whether dredging was likely to affect the yield seriously if permitted at certain seasons. The conclusions are that, provided a sufficient number of breeding adults are left on the grounds, it is probable that no harm will be done by the dredging, especially as the periwinkles are not collected from April until August, which apparently includes the main spawning period. Small specimens should, however, not be taken and sieving is recommended, also transplantation; but in their own interests the fishermen usually return undersized specimens, thus themselves contributing to the restocking of the beds. The number of specimens used for the experiments on which the curves and tables are based is exceedingly small and the observations on breeding scanty. Seeing that the veligers and very young crawling stages are quite easily recognised, it is surprising that so few were seen. It is stated that both large and small *Littorina littorea* migrate from the mud flats into the tidal pools on the approach of cold weather.

### Herdmania: a Monascidian of the Indian Seas

DR. S. M. DAS has chosen the simple ascidian *Herdmania* as a typical subject for one of the Indian zoological memoirs ("Indian Zoological Memoirs on Indian Animal Types". (5). Lucknow Publishing House, Lucknow, 1936. Rs. 2). In this useful series of publications common animals from India are substituted for those formerly imported from Europe for dissection in the zoological laboratories. The genus *Herdmania* has a world-wide distribution. Only in the Arctic seas is it absent. It possesses calcareous spicules in the tissues, and is the commonest simple ascidian of Indian seas. Two species are recorded from the coastal waters and a third in greater depths. The two coastal species investigated, *H. pallida* and *H. ceylonica*, occur in the Gulf of Mannar at 5–12 fathoms, extending as far as ten miles from the seashore where they inhabit a rocky bed with numerous polychætes and chanks. *H. pallida* is the species specially selected for description, the average size being about 9·5 cm. in length and thus well adapted for laboratory work. The author is to be congratulated on this clearly written and well-illustrated monograph. It is hoped that more volumes in this series will soon appear.

### Oysters of the Limfjord

DR. R. SPÄRCK, in a recent paper ("Investigations on the Biology of the Oyster (11). On the size and age composition of the stock of Native Oyster in 1935." *Rep. Danish. Biol. Stat.*, 40; 1935), continues work he has been doing for a number of years. In former papers (*Rep. Danish Biol. Stat.*, 31, 33, 34 and 37) he has shown that during a long series of years the size of the native oyster in the Limfjord constantly decreased, the population consisting almost entirely of old individuals, and that the stock has constantly grown less. From 1919, and even from 1914, the annual renewal of the stock has been quite insignificant; but in 1932 and after, there appeared to be an increase of existing stock of several hundreds per cent, the present age-composition of the stock being absolutely different from those former years. In the summer of 1934 the spat-fall, which in some cases showed two or three size groups, covered large areas of the Limfjord. This very satisfactory state of things is most hopeful and, if no extraordinary mortality sets in, a rise in stock of Limfjord native oysters may be expected so that in four or five years some fishing may be allowed. It is suggested that the cause of the extensive spat-falls in 1932 and 1934 may have been the high summer temperatures, which were favourable for a considerable renewal of the oysters. In the same report Dr. Spärck records the presence in the Limfjord in 1934 of *Crepidula fornicata*, the unwelcome mollusc which in 1880 was carried to England with American oysters, and has since spread widely along the southern and eastern coasts and latterly into Holland and Belgium.

### Biology of Staphylinid Beetles

THE prevalent idea that beetles of the extensive family Staphylinidæ are scavengers apparently has relatively few observations in support of the contention. According to Mr. Ralph Voris (*Trans. Acad. Sci. St. Louis*, 28, No. 8, 233–261, Dec. 1934), in most cases the food of Staphylinidæ has been confused with the habitat in which they are found. He finds that the prevailing type of feeding behaviour is predatism. In fourteen species belonging to eight genera, his observations were that either the larvæ or adults, or both, feed upon living insects. The reported cases of parasitism in the group Aleocharinæ are typical examples of parasitoid behaviour and support the contention that the family as a whole is primarily predaceous. The feeding behaviour of those forms found in the nests of social insects clearly points to the same conclusion. The border-line behaviour of Staphylinidæ supports Wheeler's view that parasitism among insects is a kind of refined predatism, and has its origin in the latter habit. The role of scavengers is only occasionally evidenced, while phytophagous behaviour is apparently rare, and so imperfectly studied, that generalisations in this respect cannot be made. A useful bibliography relating to the feeding and other habits in the family is appended to the paper.

### Biennial Bearing in Apple Trees

SOME observations on the above subject have recently been published by Hoblyn *et al.* (*J. Pom. and Hort. Sci.*, 14, 1, 39; 1936). The degree to which bearing is biennial, and the average intensity of annual fluctuations in cropping over a period of years, are expressed arithmetically by constants *B* and *I* respectively for trees subject to various treatments. Drastic pruning of previously unpruned trees tended to even up the annual crops, and the 'intensity'

was reduced more by pruning in the 'off-year' than the 'on-year'. The cropping of Newton Wonder became more regular after grassing down, but no significant results were obtained with any other variety. Potash manuring also was without effect. There are indications that rootstock may be a relevant factor over a long period, though no marked differences were observed. Stripping of blossom from trees of Early Victoria completely changed the year of cropping and increased the intensity of subsequent fluctuations, but no results were obtained by blossom thinning. Fruit thinning also had very little effect, but complete removal of fruits in June every year eliminated the biennial habit. It seems that no workable method of dealing with biennial bearing is yet available for application in commercial practice.

### An Insect Pest of Orchids

A SHORT paper by Mr. W. H. Nicholls (*Victorian Nat.*, 52, No. 11, March 1936) describes the appearance of numerous viscid blotches upon leek-orchid plants belonging to several species of the genus *Prasophyllum*. It was known that thrip-like insects were often found embedded in the viscid mass, but they were not recognised as a cause. Indeed, one infected plant of *P. australe* had been previously described as a new variety—*viscidum*. The causal relation between thrips and the viscidity has now been established, and the insect is *Thrips imaginis*, a species indigenous to Victoria.

### Molasses and Nitrogen Fixation in Indian Soils

PROF. N. R. DHAR, of the University of Allahabad, writing on April 29 with reference to the article on "Molasses, Nitrogen Fixation and Land Reclamation" which appeared in NATURE of April 11, says: "I am glad to inform you molasses is being utilised in many parts of India for reclamation of alkaline land. The Mysore Government has been able to obtain 1,200–1,800 lb. of rice grains per acre of alkaline land using one ton of molasses per acre on plots where crops failed previously. The normal production of rice in India is 1,250 lb. of grain per acre in ordinary fields. In recent publications, we have shown that the ammoniacal and total nitrogen of ordinary soils mixed with cane sugar or glucose or any other energy-rich compound and exposed to sunlight increase considerably although the *Azotobacter* counts do not change appreciably. In the dark, however, the *Azotobacter* counts are enormously increased, although the ammoniacal and total nitrogen are less than in light. Moreover, we have obtained results showing the accelerating influence of light on ammonification, nitrification and denitrification under aerobic conditions. Hence we have come to the conclusion that sunlight plays an important role in the nitrogen cycle in the soil."

### Drought Resistance in Wheat

MESSRS. O. S. AAMODT and W. H. Johnston are analysing the nature of drought resistance in wheats by a comparison of the Russian varieties Milturum and Cæsium with commonly grown Canadian types which are susceptible to drought (*Canadian J. Res.*, 14, March 1936). The Russian varieties seem equally susceptible when shooting and heading, but during the process of stooling they are much more resistant. This becomes the more significant when it is realised that Milturum has a stooling period some 8–10 days longer, Cæsium 4–5 days longer, than Marquis. In this stooling period the Russian varieties survive periods of drought that ordinarily cause great damage to other varieties. Milturum and Cæsium varieties also develop their root systems comparatively early, a characteristic which enables them to weather early periods of drought more successfully. Finally, these Russian varieties were found to possess a superior capacity to endure drought without permanent injury.

### Crustal Deformations in Japan

DURING the year 1935, new lines of precise levelling were carried across several earthquake districts in Japan. One of the most interesting series is that studied by Prof. A. Imamura (*Proc. Tokyo Imp. Acad.*, 12, 7–9; 1936). The route lies near the west coast of northern Japan and crosses the meizoseismal areas of two important earthquakes in 1694 and 1704. No definite change occurred during the last thirty-five years in the central area of the earlier earthquake, but there were undoubted movements in that of the latter. Here, the changes of level between 1903 and 1935 revealed the existence of several crust-blocks, each of which was tilted towards the north, the maximum elevation in the area being a little more than an inch. Messrs. T. Terada and N. Miyabe (*Proc. Tokyo Imp. Acad.*, 12, 4–6; 1936; and *Earthq. Res. Inst. Bull.*, 14, 146–147; 1936) describe the results of the series of levellings made in the Sanriku district (north-east Japan) from Miyako to Aomori, the general mode of deformation between 1933 and 1935 being an upwarping of the crust between Kamaisi and Hatinohe and a downwarping near Aomori Bay. Mr. R. Takahasi (*Earthq. Res. Inst. Bull.*, 14, 18–25; 1936) describes the precise levelling made for the first time up the west slope of the Asama volcano, round the southern rim of the crater, and down the east slope. Comparing the heights obtained with those given in the topographic map of 1912, it is shown that the principal vertical deformation was a rise of nearly 60 ft. in the eastern rim of the crater, a rise that must be due in part to the accumulation of volcanic material since the eruption of 1912.

### Canadian Crude Oils

DURING recent years a wealth of information has been accumulated at fuel research laboratories on crude oils from the various producing fields of Canada. In view of the increasing importance of petroleum developments in that country and of advancement in refining technology, it has been deemed advisable to publish the data collected in the form of a comprehensive report. The document bears the title "Analyses of Canadian Crude Oils, Naphthas, Shale Oil and Bitumen" and is published by the Canadian Department of Mines (Bulletin 765), the joint authors being P. V. Rosewarne, H. McD. Chantler and A. A. Swinnerton. One hundred and forty-three samples of crude oil were collected over a period of some five years from Canadian fields, and detailed analyses of these, together with notes on methods of examination, form the main part of the report. In addition, results are interpreted, distillates classified, and comparisons made of typical crude oils. The report also includes a brief description of each of the main producing fields, supplemented by an outline map on which these fields are clearly marked and positions of individual samples indicated; a summary of production from each field during recent years; and statistics of the petroleum industry

for the whole country. At the present time, only three per cent of the annual consumption of crude oil in Canada is supplied from home fields, the rest being imported. The remedy for this unsatisfactory position lies first in discovery of new producing fields and secondly in commercial development of bituminous sands in Alberta and oil shale in the Maritime Provinces. This latter course would provide an alternative raw material to crude petroleum from wells for the production of motor spirit and oil products. When crude oil prices stand at a higher level, this should prove a useful resource.

### History of the Dines' Anemometer

IN his presidential address delivered last January to the Royal Meteorological Society and entitled "Wind in Britain: The Dines Anemometer and Some Notable Records during the last Forty Years", Colonel E. Gold traced the historical development of the instrument devised by the late W. H. Dines, from various attempts by earlier workers to make use of the pressure exerted by the wind down a tube directed towards it as a measure of wind velocity (*Quart. J. Roy. Met. Soc.*, **62**, No. 264). In these early instruments, which were generally of the water-filled U-tube pattern, the fallacious assumption was made that the pressure on the arm open to the air, but not exposed to the wind, is constant. Dines arranged for the pressure of the wind down an open tube to act on the underside of a float in water, and for the lower pressure caused by the wind blowing past holes in a vertical tube to act on the upper side of the float. These effects, for a given air density, vary as the square of the wind speed, which necessitated a specially shaped float to make the vertical movement of the float, and the recording pen supported by it, proportional to the increase of wind speed. The required shape of float was worked out from first principles. Accuracy in this instrument was limited by the fact that variations in the density of the air, which affect the pressure of the wind, could not be allowed for. In the British Isles, however, the error due to this cause scarcely ever reaches five per cent, and the instrument, after gradual improvements suggested by experience, has come to occupy a unique position and to achieve a world-wide distribution. In the discussion of notable records, a very remarkable case of disturbance caused by a row of cottages 100 feet away from an anemometer at the Lizard is illustrated; when the vane was 15 feet higher than the ridge of the cottages the wind constantly 'boxed the compass' during the violent fluctuations caused by the obstruction, although very steady when the direction was two or three points off that of the obstruction, the speed dropping frequently to nil; raising the vane 35 feet caused the disturbance to disappear altogether.

### Acoustical Terms

THREE years ago the British Standards Institution set up a committee to prepare a "Glossary of Acoustical Terms and Definitions" which has now been issued. It extends to 48 pages and is published by the Institution at 3*s*. 6*d*. In general, the definitions are on established lines but are given in more precise forms. Pulsatance is introduced for $2\pi$ times the frequency, logarithmic decrement is in terms of deflections on the same side, stationary used instead of standing wave system, the logarithm to base 10 of the ratio of the rates at which energy is emitted by two sources is the number of bels of power separating them. A new unit—the phon—is introduced to express the loudness of a sound in terms of the intensity of one of standard pitch. Unit area impedance is the quotient of the pressure by the particle velocity and is generally a complex quantity. Other electrical terms—resistance, reactance, transducer, microphone, filter—are adopted and defined, and musical terms are interpreted on a physical basis.

### Deflection of Fast Electrons in Magnetised Iron

A NUMBER of experiments have been performed in which cosmic ray electrons (or in one case $\beta$-rays) are passed through magnetised iron, and there is some interest in trying to find what is the effective magnetic vector deflecting the particles. The experiments seem to show that this vector is less than the induction $B$. W. F. G. Swann (*Phys. Rev.*, April 15) considers the iron as containing a number of very small magnetic entities (for example, spinning electrons) and shows that, while $B = H + 4\pi I$ does give the true average force deflecting the particles, this average is made up in a peculiar way. A very small number of particles receive large deflections as a result of penetration of the magnetic entities, while for most of the electrons the effective deflecting vector is $H + 2\pi I$. An experimental paper by W. E. Danforth and W. F. G. Swann follows, in which cosmic ray electrons were detected by counters after passing through several centimetres of an iron magnetic circuit. Using Anderson's and Kunze's data on the energy statistics of cosmic ray electrons, the results are found to agree in order of magnitude with the theory.

### Deuterium and Molecular Asymmetry

IN order to test whether the replacement of one hydrogen atom in a methylene group by deuterium is sufficient to produce a measurable degree of molecular asymmetry, E. Biilmann, K. A. Jensen and E. Knuth have carried out some interesting experiments (*Ber. deutsch. chem. Gesells.*, May). The replacement of one hydrogen atom by deuterium is likely to have so small an effect on the symmetry of the molecule that optical resolution of a synthetic racemic compound could scarcely be expected to yield convincing results. Accordingly they adopted the method of replacing chlorine in an optically active compound by deuterium, where ordinary hydrogen was bound to produce inactivity. For this purpose *l*-bornylchloride was converted in parallel experiments to camphane, $C_{10}H_{18}$, and 2-deutero-camphane, $C_{10}H_{17}D$, by decomposing the magnesium derivative with light and heavy water respectively. In both cases, the final product had to be freed by distillation from the high-boiling *d*-hydrodicamphene and by fractional recrystallisation from *l*-camphene. The two final products melt sharply at a temperature (153° C.), which is unaffected by mixing the compounds, but whereas camphene is symmetrical and therefore optically inactive, 2-deutero-camphane is slightly active and indeed shows reversal of sign for sodium light. Thus from observations with a ten per cent solution in ether, the specific rotation $[\alpha]_D$ at 20° C. was calculated to be $+0.40° \pm 0.05°$. The effect is certainly slight, but appears to be unmistakable. The heavy water used was from the Norsk Hydro-Elektrisk Kvaelstofaktieselskab, and contained 99·2 per cent of deuterium oxide.

# Royal Observatory, Greenwich

## ANNUAL VISITATION

THE Astronomer Royal read his annual report to the Board of Visitors of the Royal Observatory, Greenwich, on June 6 last. Although the weather was far from ideal, the Garden Party which is associated with the visitation was well attended, and visitors and guests were shown the new Reversible Transit Circle referred to in the Report. The erection of this instrument was commenced in February and completed in March, but actual observations have not yet been made with it, as it was discovered by tests that the pivots were slightly elliptical in shape; in the meantime, work has been done on the pivots which it is hoped will shortly be circular within the required limits. This Transit Circle is in the Christie Enclosure, near the Yapp Reflector, and is accordingly some little distance east of the adopted Greenwich Meridian on which Airy's Transit Circle will continue to stand; the new instrument is reversible and has a travelling micrometer wire which is driven by an electric motor at the speed appropriate to the declination of the star under observation. It is intended to secure observations in fundamental astronomy which will be more accurate than those obtainable with the Airy's Transit Circle, and we may await with some interest the appearance of the results obtained with the new instrument.

A new Free Pendulum Clock is being presented to the Observatory by Mr. H. R. Fry. This clock is a Shortt clock which is similar to those at present in use, except that the slave pendulum of the new clock is of a much more refined construction than the standard pattern and is fully jewelled throughout. The time will be taken from the new clock from the free pendulum itself using a photo-electric method.

The routine astronomical work of the Observatory continues. During the year, 9,899 transit observations and 9,409 observations of zenith distance were secured. Attention has been directed to the minor planets, which are being observed with the intention of using them to fix the equinox and equator point, and 42 transit observations of minor planets were secured during the year, in addition to 139 photographic observations secured with the Astrographic Equatorial. The Astronomer Royal directs special attention to the successful application to the measurement of line contour with the spectrohelioscope which has recently been accomplished at Greenwich. A programme of photometric observations of intensity of bright eruptions and dark markings on the solar disk is now in hand. The observers use a visual method of photometry, and the results promise to be of interest in connexion with the investigation of conditions in the ionosphere besides having astrophysical significance.

The mean values of the magnetic elements at Abinger in 1935 are given below, together with values in recent years for comparison:

| | Declination, W | Horizontal Intensity | Vertical Intensity | Inclination |
|---|---|---|---|---|
| 1932 | 12° 2·6′ | 0·18536 | 0·42940 | 66° 39·1′ |
| 1933 | 11° 51·7′ | 0·18532 | 0·42942 | 66° 39·4′ |
| 1934 | 11° 41·1′ | 0·18533 | 0·42955 | 66° 39·7′ |
| 1935 | 11° 30·3′ | 0·18527 | 0·42981 | 66° 40·9′ |

Regular observations of the amount of solid matter polluting the atmosphere have been continued. A comparison between the pollution at Greenwich during the winter of 1934–35 with the pollution at the worst London station (Westminster) and the worst Glasgow station reveal the fact that Greenwich experiences rather more than fifty per cent more pollution than either of the other stations. During the winter 1935–36, less pollution was observed at Greenwich: the decrease is attributed to the smaller proportion of wind coming from a northerly direction experienced in 1935–36, as the main source of pollution lies in the factory area along the Thames and the densely populated area north of the river, opposite Greenwich. The worst pollution occurs at $20^h$, indicating domestic fires as an important source of atmospheric impurity.

The mean temperature for the twelve months ending April 30, 1936, was 50·2°, which is 0·7° higher than the average for the seventy-five years 1841–1915. The year was remarkable for a temperature below freezing point registered on May 17, 1935.

Hitherto the time service maintained by the Observatory has suffered from a lack of precision in so far as the absolute personal equations of the observers who observe clock corrections with the Small Reversible Transit telescope are not known. A personal equation machine has been constructed with the view of determining these personalities. The machine carrying an artificial star has been installed on the roof of the Octagon Room, and the movement of this artificial star will be observed with a telescope similar to that used in the observations for clock correction which will be mounted on the roof of the Main Building. It is expected to commence these observations shortly. Meanwhile, the annual mean differences between the Greenwich time signals and those sent out by Paris, Nauen and Bordeaux are satisfactorily small, being $-0·009^s$, $-0·010^s$ and $-0·009^s$ respectively, the other observatories being in the mean early on Greenwich.

The old system of employing unestablished computers at Greenwich is to go. This scheme was instituted by Sir George Airy, and it worked admirably in the past. Some of the boys employed as temporary computers were incorporated in the established staff and have gone on to render distinguished service as assistants at the Observatory; others who have left have found their Greenwich training of great service to them, and several have gone on to hold very responsible appointments. But the times have changed and there is no longer a market amongst employers for an accomplished computer, with the result that computing at Greenwich is now a blind-alley occupation for a young man, since all the computers could not be absorbed on the established staff. The Lords Commissioners of H.M. Treasury have approved a new scheme according to which the unestablished computers will disappear while the permanent staff will be increased, the computing duties being performed for the most part by twelve established women writing assistants. The transition will be made gradually.

# Problems of Plant Classification

THE Masters Lectures of the Royal Horticultural Society were delivered in 1935 by Sir William Wright Smith, who chose as his subject "Problems in Classification of Plants". A very considerable field of botanical research was reviewed in the two discourses (*J. Roy. Hort. Soc.*, 61, No. 2, 77–90 and No. 3, 117–134, February and March, 1936).

Beginning with the need of the gardener for definite names for his plants, Sir William traced the history of plant groupings. He commenced with Theophrastus, Dioscorides and Pliny, evaluated the work of Cæsalpinus, Ray and Tournefort, made suitable homage to the genius of Linnæus, and also reviewed the more recent work of Darwin, Hooker and others. A teacher of classification would there find a useful, if succinct, résumé of taxonomic history.

Sir William's deft handling of the vexed question of the subdivision or condensation of species is shown by his definition that "a 'splitter' is one who fails to recognize that his three species are only one, as you see it, while a 'lumper' is so bold as to include in one species what you clearly see contains at least six different ones". Inequality in the application of criteria to genera was discussed, and Sir William urged that sharp and wide diversity of generic characters should have value as a possible indication of a primitive nature. The genera of the Polypetalæ, for example, stand out more distinctly from one another than do those of the less primitive Gamopetalæ. The subdivision of sharply-defined primary units of classification, such as the Leguminosæ, was deprecated.

Much recent work upon intergeneric hybrids was marshalled to show that a broad concept of the genus is more in keeping with the facts presented by Nature, and no useful purpose is served by separating plants which give such adequate testimony of their affinity.

Classification must eventually stand the test of utility, either for accurate nomenclature, or as an indication of phylogeny, and to the gardener, species are almost invariably the broader concepts of Linnæus, rather than the unserviceable subordinate units of more modern tendency. The trend towards subdivision of species through natural hybridisation is greater in some parts of the world than in others—it is common in New Zealand, and rare in the Himalayas and western China. A recent analysis by Sir William and Mr. H. F. Tagg made it possible to determine the genetic constitution of several rhododendrons, and to prophesy, with some measure of success, which combinations could ultimately be found by exploration. The possible contributions of genetics to taxonomy were discussed, though it is still too early to appraise this point of view.

Sir William is, in the designation of his lectures, obviously a 'lumper', yet a 'splitter' could find no reasonable complaint in this quite impartial analysis of classification problems.

# Association of Teachers in Technical Institutions

## ANNUAL CONFERENCE AT PLYMOUTH

THE twenty-seventh annual conference of the Association of Teachers in Technical Institutions was held at Plymouth during Whitsuntide, when the president for 1936–37, Mr. W. T. Maccall, head of the Electrical Engineering Department, Sunderland Technical College, was inducted by the retiring president, Mr. D. W. Lloyd, principal of the Technical College, Stretford, Manchester.

In his presidential address, Mr. Maccall referred to the many new demands which the development of the petrol engine and the ever-widening use of radio and the films make upon the technical college. These demands touch nearly all departments of technical work, and range from the need for schemes of certification of garage attendants to the growing and varied courses in workshop management and production engineering.

Despite the suggestion that the art of invention is making workers into machine-minders, Mr. Maccall referred to the shortage of skilled workers, particularly in the several branches of the engineering industry. He asked how far that shortage is due to the lack of a proper recruitment policy, and how far to circumstances beyond the control of industry. Clearly a scientific age demands a scientific planning if the danger of lack of skilled workers is to be averted. Each industry must consider what type and grades of workers it requires. It should make a complete review of its methods of recruitment, conditions of service, and the normal number of its annual recruits. In proper conjunction with the local education authorities and the Board of Education, educational provision for every type of worker could be ensured. Mr. Maccall expressed the opinion that, broadly speaking, industry has not co-operated fully with education. In many cases, such full co-operation has been prevented by fear. Employers have 'feared' that technical colleges are training all to become works managers. Trade unions have 'feared' that colleges are short-circuiting apprenticeship and providing cheap labour. It should be widely known that colleges cannot *make* engineers, builders, etc.: they can but teach the underlying principles.

After a review of matters concerning examinations, the raising of the school-leaving age, the arguments against the multiple-bias secondary school and the possibilities of the junior technical school, Mr. Maccall referred to the relationship of the technologist to the world about him. Despite the joy which lies in seeing the applications of technology applied to the benefit of mankind, the technologist sometimes tends to lose hope when he surveys the world and sees, over

certain of its great and important tracts, his specialist knowledge seized and directed in the service of might rather than right. He sees ideals overthrown and reason treated with contempt. He sees freedom of speech threatened and the visions of democracy spurned. He sees education itself made subservient to ignoble ends, and he asks sometimes what he as an individual or as a member of an association can do when values become so twisted and the world appears to move towards such disastrous ends. The man of science, said Mr. Maccall, believes in the methods of reason and freedom. The technical institution, despite the charge which is sometimes made of narrow specialisation, would fail to be scientific if specialisation produced ignorance of the ways and aims of mankind. Students must be trained to think clearly not only about the special subjects, but also about the relationship of those subjects to a world contracted and spanned by wireless, by the cinema and by the internal combustion engine. Citizenship is a matter of scientific thinking just as much as any more obviously scientific subject.

The resolutions debated and passed by the Conference included one which urged the development of full-time and part-time day courses in technical education rather than the present system in which so much technical work is done in the evening. Other resolutions dealt with overtime and the shift system, the school leaving age, recruitment in industry and the extension of technical education. In connexion with the latter, the Conference welcomed the policy of the Government, which is to make increased financial provision, but asked that in the allocation of financial assistance, special regard be had to the needs of depressed areas.

Mr. John Sargent, director of education for Essex, addressed the closing meeting of the Conference. He outlined the policy which is guiding the development of technical education in Essex—a county which was once largely rural and in which areas are now rapidly becoming industrialised. The first step in connexion with that policy is to create four large technical colleges. Their buildings, as well as their curriculum and organisation, have been designed to give the greatest flexibility. The old idea of one industry dominating one area would in the future be avoided. In places like Dagenham, for example, there are new and diversified industries. They can therefore look forward to an escape from the general depression which devastates a 'one industry' area when that one industry falls upon evil days.

# Sea Fisheries of Europe

ONE of the most valuable of the various publications of the Conseil Permanent International pour l'Exploration de la Mer is its Statistical Bulletin, in which are tabulated the statistics relating to the sea fisheries of all the maritime countries of northern and western Europe. Such ample and diverse data require much time and labour to assemble and work up; vol. 23*, which has just appeared, presents the data for the year 1933. For the use of those whose interest in the work and welfare of the great fishing industries may exceed their ability to interpret detailed tabular data, a very comprehensive yet extremely lucid summary of the statistical tables is given.

The British reader, unfortunately, will derive but little comfort from the tale this Bulletin has to tell. The total quantity of fish landed by all the countries concerned—from Norway to Portugal—was greater by some 200,000 tons (about 6 per cent) in 1933 than in 1932. It was 5 per cent less than the 1930 yield (the highest on record) but 26 per cent greater than in 1913—the last normal pre-War year. Unfortunately, Great Britain has no share in this increase. Both absolutely and relatively, English and Scottish landings have fallen sharply. The English landings, though only very little smaller in 1933 than in 1932, showed nevertheless a decrease of no less than 15 per cent on pre-War figures. In Scotland the fall has been even greater. In 1933, Scottish landings diminished by 12 per cent as compared with 1932, and by as much as 36 per cent as compared with 1913.

A very different state of affairs is revealed in Norway, Germany and Iceland, each of which has had a very marked increase. In fact, almost every important fishing country except Great Britain shows increased landings in recent years. The accompanying table of the total quantity of fish landed (in thousand tons) is highly illuminating, though somewhat disquieting from the British point of view.

| | Total Quantity | | | | Ratio to 1913 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1913 | 1931 | 1932 | 1933 | 1913 | 1931 | 1932 | 1933 |
| Iceland ... | 92 | 311 | 288 | 328 | 100 | 338 | 313 | 357 |
| Germany ... | 181 | 370 | 353 | 387 | 100 | 204 | 195 | 214 |
| Norway ... | 732 | 843 | 1019 | 1162 | 100 | 115 | 139 | 159 |
| France ... | 193 | 247 | 262 | 277 | 100 | 128 | 136 | 144 |
| England ... | 821 | 752 | 702 | 698 | 100 | 92 | 86 | 85 |
| Holland ... | 147 | 168 | 116 | 111 | 100 | 114 | 79 | 76 |
| Scotland ... | 398 | 263 | 292 | 255 | 100 | 66 | 73 | 64 |

The fishing grounds from which the fish are drawn extend from Bear Island to Morocco; but the North Sea still retains its position as "the most interesting, the most important and the most productive" of them all. From 1924 until 1933, the North Sea yielded on an average about 1,155,000 tons of fish a year. 1,171,000 tons were landed in 1933—a quantity which was exceeded only twice in the ten-year period. Relative to the grand total of fish from all grounds, however, the North Sea's contribution is tending to fall slightly. This is due not to any actual decrease in its own productivity, but to increased landings from elsewhere. Over the ten years 1924–33, the North Sea yielded an average of 34·4 per cent, or a little more than one third of the grand total. But in 1924 it yielded 39·7 per cent, whereas in 1933 the proportion had dropped to 31·7 per cent.

That the North Sea maintains its yield is a satisfactory condition little expected by the prophets of twenty years ago. Nevertheless, the constancy of the yield is quantitative only; qualitatively, considerable change of a disturbing kind has taken place.

* Bulletin Statistique des Pêches Maritimes des Pays du Nord et de l'Ouest de L'Europe. Vol. 23 (pour l'année 1933). (Copenhague: Andr. Fred Høst et Fils, 1935.) Kr. 3,00.

The average size of certain important fishes, for example, plaice, soles and haddocks, in the North Sea landings has been materially—perhaps even alarmingly—reduced. In other words, an increased proportion of the catches now consists of small fish. For full details of this and other changes in the nature of the landings the reader must consult the tables as set out *in extenso* in the Bulletin. But certain important details concerning the North Sea plaice may be usefully included here.

It is now generally known that the percentage of small plaice landed in England fell rapidly during the Great War. From 45–50 per cent in the immediate pre-War years, it dropped to 24 per cent in 1915 and even fell so low as 7 per cent in 1919. After that year, it rose again, and has kept a steady average of about 70 per cent from 1925 onwards. Thus, during the War and for several years afterwards, the English market was supplied with plaice larger on an average than either before or afterwards. Temporary abandonment of 'small fish' grounds is not regarded by the compiler of the Bulletin as a satisfactory explanation of this; nor does he regard with favour the more usual suggestion that the North Sea plaice had a respite from too intensive fishing during the War so that a larger number lived longer, grew bigger and eventually came into the market until the accumulation dwindled. On this point, attention is directed to the significant fact that, in England, the proportion of small plaice began to fall in the year 1914, *before* any great restriction of fishing grounds had taken place and long before the fish on any closed area had had time to grow. It is interesting to note that the haddock showed no sign of any post-War period of comparatively large fish, that is, there was no benefit from partial closure of the North Sea grounds.

With regard to the other plaice-producing countries, we find that in the seven years 1907–13 the mean percentage of small plaice was 47 per cent in England; 83 per cent in Germany; 87 per cent in Holland. In the seven years 1927–33 the corresponding figures are given as 74 per cent, 90 per cent and 95 per cent. Whatever be its cause or causes, this great increase in the percentage of small plaice—and other fishes—in the North Sea catches is a phenomenon the effect of which on the future of the fisheries of Great Britain and other countries seems likely to be of extreme importance.

## Uplift Pressure on Dams

WHEN a dam is built on porous strata such as generally exist at the beds of rivers, there is a flow through these porous strata under the masonry from the upstream to the downstream side. Accompanying this, there will be a pressure acting upwards on the masonry floor. An accurate knowledge of this uplift pressure and of the nature of its distribution is of fundamental importance for the purpose of designing a dam. There have been many attempts to investigate by direct measurements from models the way in which this pressure varies with different forms of design.

The usual method of building a tank provided with holes for manometers and filled with sand to represent the subsoil strata and of arranging a model of the dam with a suitable head of water upstream involves a very large number of readings, and is most laborious. Observing the analogy between Ohm's law for the conduction of electricity and Darcy's law for the conduction of water through porous media, N. N. Pavlovsky in 1921 suggested that an electrical method could be employed for studying the subsoil pressures under dams (Proceedings of the International Congress on Dams, 1933). In a paper to the Indian Academy of Sciences (*Proc.*, 2, No. 1, July 1935), Mr. G. Ram, Dr. V. I. Vaidhianathan and Dr. E. McKenzie Taylor, of the Irrigation Research Institute, Lahore, have described their investigations and the methods and apparatus used in determining to what extent this suggestion could be made the basis of a successful attack on the problem of subsoil flow under dams.

In the several cases examined of simple impervious floors with and without sheet piling, the curves obtained by the direct and the indirect methods and by theoretical calculations agreed so closely as to give support to the claim of the authors that the indirect electrical method is trustworthy. They consider that earlier failures have been due to faulty technique, and assert that the fact that the potential distribution in conductors has been shown to be of the same form as the pressure distribution in the subsoil under dams, establishes the mathematical foundation for designs of these works, and, as such, should be considered a great advance on our existing knowledge.

## Educational Topics and Events

BIRMINGHAM.—The Poynting chair of physics, which will be vacated by the retirement at the end of the present session of Prof. S. W. J. Smith, is to be filled by the appointment of Dr. M. L. Oliphant, assistant director of research in physics at the Cavendish Laboratory, Cambridge.

Mr. J. W. Drinkwater has been appointed lecturer in mechanical engineering.

CAMBRIDGE.—C. H. Thompson, Queens' College, has been appointed Gurney lecturer in forestry, and J. H. Lockhead, Christ's College, University demonstrator in zoology.

In its annual report, the Committee of Management of the Scott Polar Research Institute states that the Oxford University Expedition to North East Land before its departure, and the Oxford University Ellesmere Land Expedition 1934–35, since its return, have both made use of the facilities of the Institute, which have also been of service to the forthcoming Cambridge expeditions to Iceland, members of which have been at work for some time in the library and map room.

DURHAM.—At the Convocation to be held on June 30, the honorary degree of D.Sc. will be conferred on Mr. G. S. Baker, superintendent of the William Froude Laboratory at the National Physical Laboratory, and the honorary degree of D.Litt. on Mr. Robert Steele, editor of the works of Roger Bacon and other medieval literature.

OXFORD.—On June 6, the honorary degree of D.Litt. was conferred on Mr. E. A. Lowe, University reader in palæography. At Encænia on June 24, the honorary degree of D.Sc. will be conferred on Prof. E. D. Adrian, Foulerton research professor of the Royal Society. Among those who will then receive honorary degrees of D.C.L. are Prof. Gilbert Murray and Mr. Anthony Eden.

IT is stated that some two thousand people representing fifty different countries will be present at the Seventh World Conference of the New Education Fellowship to be held at Cheltenham on July 31–August 14, under the presidency of Sir Percy Nunn. The theme of the Conference will be "Education and a Free Society". One main lecture will be delivered each day and translated from French into English or vice versa; the same evening the lecture will be discussed in a symposium, to which educationists from different lands will contribute. During the first week, the Conference will consider "The Individual and Freedom" and during the second, "Human Relationships and Freedom". Particulars can be obtained from Miss Clare Soper, 29 Tavistock Square, London, W.C.1.

RESEARCH studies in education occupy some thousands of university graduates every year in the United States. A bibliography published by the Office of Education, Washington, as Bulletin No. 5 of 1935 (pp. 328, price 25 cents) lists 3,506 such studies reported in 1933–34, including 465 doctors' dissertations, 2,763 masters' theses and 274 studies reported as faculty research. Many of them deal with topics of current controversies: special taxation for support of schools, equalisation of educational opportunity, emergency feeding, emergency schools, effects of the depression, child-labour and unemployment, the new systems of education in Italy, U.S.S.R., Greece and Germany, Federal emergency relief and leisure-time activities. The Office of Education has in its library a collection of 1,811 of these studies, which is said to be in constant use both in Washington and, through inter-library loans, throughout the country.

## Science News a Century Ago

### William Radcliffe and the Textile Industry

WILLIAM RADCLIFFE (1760–1841) was one of the improvers of cotton machinery who failed to reap any reward for his work. He died in poverty in 1841. *The Times* of June 14, 1836, contained the following quotation from *Blackwood's Magazine* regarding him: "The power-loom system, commonly so known, ought to be called the Radcliffe system. Without the dressing machine invented by Mr. William Radcliffe, of Stockport, the power loom was utterly worthless, except as a piece of curious mechanism. That of Dr. Cartwright has never been other than useless; yet he obtained a grant from Parliament of £10,000 for the invention. Mr. Samuel Crompton, for his splendid discovery of the spinning mule, received the niggardly award of £5,000 from the same source; but Mr. Radcliffe was beggared by his inventions. His patents were invaded by a joint-stock purse combination; and he himself, from a prosperous manufacturer, brought to bankruptcy through expenses, time, and labour lavished upon his valuable inventions. . . ."

### Ventilation at the Custom House

AT the last ordinary meeting of the session of the Royal Society held on June 16, 1836, twenty communications were made. Among the subjects dealt with were the tides, magnetic observations, the respiration of insects, the human voice, the fermentation of vegetable matter, voltaic batteries and heating and ventilating. After the meeting, the Society adjourned for the long vacation to meet again on November 17.

The paper on warming and ventilating apartments was by Dr. Andrew Ure (1778–1857), then an analytical chemist in London. He had, he said, been consulted by the directors of the Customs Fund of Life Assurance, on the mode of ventilating the Long Room in the Custom House. In this room, about two hundred persons were employed. All these persons were found to suffer more or less from ailments of the same general character, the leading symptoms of which were a sense of fulness and tension in the head, throbbing of the temples, giddiness and occasional confusion of ideas, depriving them of the power of discharging their duties, in which important and frequently intricate calculations were required. Dr. Ure examined the condition of the air in the room, and said that: "In all these qualities the air respired by the inmates of the room bears a close resemblance to the pestilential blasts of wind, which, having passed over the scorching deserts of Arabia and Africa constitutes the *Simoom* of those regions, and is well known by its injurious effects on animal and vegetable life."

Dr. Ure expressed surprise that in the report of the Parliamentary Committee on Ventilation, no reference had been made to the methods employed in factories, although they afford the best models for imitation, being the results of innumerable experiments made on a magnificent scale, with all the lights of science and all the resources of the ablest engineers. He showed that the ventilation effect of a steam-driven fan was thirty-eight times greater than the effect produced by a fire using the same amount of coal.

### Reform of Medical Education

IN *The Times* of June 16, 1836, a letter appeared from "M. D.", the object of which, he said, was to direct attention "to a subject which I am quite sure will be acknowledged by every medical practitioner in the kingdom to be of the first importance to the community. . . . I allude to the unprotected state of the obstetric department, a branch of medicine practiced by males and females without any responsibility, and by too many who are perfectly ignorant, or who possess a superficial knowledge only, of the important duties which they are often called upon to perform. . . . At the present moment, there is not even the form of an examination by either of the English medical corporate bodies into the acquirements of either male or female practitioners. This, Sir, is a simple statement of a monstrous anomaly which exists in the medical profession."

### The Sussex Scientific and Literary Institution

ON June 18, 1836, the *Athenæum* published a note from a correspondent regarding the above institution, which he said "owes its existence to the exertions of Mr. Ricardo, Mr. Horace Smith, Sir Richard Hunter, and a few other gentlemen, who originated a plan for the admission of the public to Dr. Mantell's Museum of Geology and Comparative Anatomy. . . . Reading rooms are opened for the members; the formation of a library is commenced; and the unique collection of organic remains, belonging to Dr. Mantell, are exhibited in these rooms and arranged with great taste. Dr. Mantell has given three lectures in the Town Hall on behalf of the Institution; and a short time since, a geological excursion to Lewes took place, under his guidance, and he conducted the members to the quarries, which had afforded many of the interesting organic remains in the Museum."

# Societies and Academies

## PARIS

**Academy of Sciences**, May 4 (*C.R.*, **202**, 1469–1540). ERNEST ESCLANGON: The dynamics of limited relativity applied to central forces. The case of the planets. VICTOR GRÉGOIRE was elected *Correspondant* for the Section of Botany in succession to the late Hugo de Vries. C. TIKHOTZKY: The $K$ transformation of congruences. NATAN ARONSZAJN: $N$-dimensional homotropy. ALEXANDRE GHIKA: A property of functions representable by Cauchy's integral. H. MILLOUX: The study of meromorph functions in a circle. CHARLES JAEGER: Theory of the ram strokes in forced [water] mains with multiple characteristics. Distribution of the resonance surcharges along any main. G. RUMER: Wave theory of the neutrino. ARSÈNE DATZEFF: The properties of the acceleration operator and a remark on potential. ALBERT ARNULF, DANIEL BARBIER, DANIEL CHALONGE and MLLE. RENÉE CANAVAGGIA: Results of the study of 48 stellar spectra made at the Jungfraujoch in 1935. ALEXANDRE PROCA: The fundamental equations of elementary particles. J. CLAEYS, J. ERRERA and H. SACK: The absorption of ultra-sounds in liquids. Confirmation of work by Biquard, with extension to a wider range of frequencies. The absorption measured is many times that calculated from the classical formulæ. CHARLES REICHART: The electrification of insulating liquids by flow or filtration. With petrol as the fluid, it was found that the negative charges hitherto observed are only the beginning of the phenomenon, and were followed by positive charges. During the purification of the petrol, it was noted that electric charges were produced by filtration. PIERRE JOLIBOIS and PIERRE DE BECO: Faraday's law and electrolysis by the spark. W. UYTERHOEVEN and C. VERBURG: The temperature of the electrons ($T_e$) in a discharge in the positive column in a neon–sodium mixture. ROBERT J. WALEN: The disintegration of boron by neutrons. GEORGES GOLDFINGER: Study of the photochemical decomposition of azomethane. No definite order can be assigned to the reaction. It may vary between 0 and 2. The experimental results are given graphically. RENÉ AUDUBERT and OTAKAR VIKTORIN: The emission of ultra-violet light during the anodic oxidation of aluminium. WILFRIED HELLER: The dynamic principle of thixotropic solidification and its application. JEAN AMIEL: The application to the slow combustion of benzene of the theory of chain reactions. The author shows that there is no real contradiction between his experimental results and those of Hinshelwood and Fort. A formula is developed which accounts qualitatively for both sets of experiments. GEORGES COSTEANU and PAUL RENAUD: The diffusion of gases on leaving capillary tubes. MLADEN PAIĆ and MLLE. VALÉRIE DEUTSCH: The absorption of proteins. The influence of salts on the adsorption of hæmoglobin by kaolin. MARCEL PATRY: The potassium tellurates. Analogy with sulphates and selenates. The potassium salts, metatellurate, selenate and sulphate, give analogous X-ray diagrams. The metatellurate is not isomorphous with the osmate. ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT: The Raman spectra of some substituted cyclohexenes. PIERRE CARRÉ and P. JULLIEN: Pyruvyl chloride. One of the products of the reaction between thionyl chloride and pyruvic acid in the presence of pyridine is pyruvyl chloride. It could not be isolated but was identified by forming its anilide. GILBERT MATHIEU: The Givetian age of the marbles of Ville-Dé-d'Ardin (Deux-Sèvres). DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The measurement of the amount of ozone in the lower layers of the atmosphere during the winter at Abisko (Swedish Lapland). MLLE. MADELEINE FOURCROY: The progressive attenuation of the acceleration transmitted to a rootlet by a wounded root. JEAN CHAZE: Complements to the study of the humoral properties of the mushroom towards the mole. MLLE. ANDRÉE TÉTRY: Description of a worm new to the French fauna, *Eisenia metallorum*. RADU VLADESCO and GEORGES NICHITA: The influence of pilocarpine on glandular and muscular metabolism. ANDRÉ KLING and GUY LECORDIER: The influence exerted by vitamin D and by certain cancer forming hydrocarbons on the values taken by the hydrophily coefficient of the lipids. JACQUES POCHON: Ubiquity and plasticity of *Plectridium cellulolyticum*.

## AMSTERDAM

**Royal Academy** (*Proc.*, **39**, No. 4, April, 1936). F. M. JAEGER, E. ROSENBOHM and R. FONTEYNE: The exact measurement of the specific heats of metals at high temperatures (23). The calorimetric, electric and thermoelectric behaviour of ductile titanium. (1), (2) and (3) Measurements on purest titanium of the specific heat, electrical resistance and thermoelectric E.M.F. against gold show the transition point $\alpha \rightarrow \beta$ titanium at 905° C. as well as a number of subsidiary transition points, the nature of which is investigated. E. ROSENBOHM and F. M. JAEGER: The determination of the thermoelectric force of metals in a vacuum by means of the photographically recording double galvanometer. Application of the Saladin–Le Chatelier method to the determination of the electrical resistance of iron and the thermoelectric forces of the Fe-Cu and Ni-Cu thermocouples at high temperatures. A. VAN KREVELD and L. S. ORNSTEIN: The most general photographic density law. Mathematical discussion of the most general law and comparison with experimental data. L. S. ORNSTEIN and H. BRINKMAN: Remark on the paper "The Mechanism in the Positive Column of a Discharge". Generalisation of an equation given in a previous paper by the authors and T. Hamada. J. DE VRIES: Configurations of points and circles. J. G. VAN DER CORPUT: Distribution functions (7). J. G. VAN DER CORPUT: On some Vinogradoff methods (2). R. WEITZENBÖCK: On the theory of $p$-relations. A. A. NIJLAND: Mean light curves of long-period variables (27). R. Canum Venaticorum. The light of this star varies with a period of 326 days and an amplitude of 2 magnitudes. J. H. DE BOER, W. G. BURGERS and J. D. FAST: The transition of hexagonal $\alpha$-titanium into cubic $\beta$-titanium at a high temperature. Electrical resistance and X-ray measurements indicate the existence of a transition at 882 $\pm$ 20° C. C. S. MEYER: Some integrals from the theory of Bessel and Whittaker functions (2). C. A. SPIERENBURG: The comitant system of a cubic and two quadratic binary forms. M. P. BOTH: Transport of nitrogenous substances under the influence of differences in humidity. Transport occurs when there is a difference in humidity between different leaves, and takes place through the sieve tubes. B. VAN DER EYKEN: Dentition and teeth development in the irisforelle (*Salmo irideus*) (4). Intermaxillary and ploughshare bone. J. OHM:

Interference of several kinds of nystagmus. A. DE BUCK: Degenerated cysts and black spores in *Anopheles* infected with benign tertian malaria. Typical banana-shaped black spores are not found before the cysts reach maturity, and are never found in uninfected *Anopheles*.

### CRACOW

Polish Academy of Science and Letters, March 2. F. LEJA: A family of harmonic functions in the plane connected with a given function on the frontier of a domain. T. BANACHIEWICZ: Various points concerning the theory of stars with eclipses. E. R. SMITH and M. WOJCIECHOWSKI: A differential method for determining density by means of twin flasks. The method is capable of measuring the density of a solution of heavy water in comparison with that of ordinary water with an accuracy of one part per million. B. KAMIENSKI and B. ZAPIOR: The dielectric potential and surface tension of β-eucaine, procaine and orthocaine for various concentrations of hydrogen ions. J. TOKARSKI: The podolian loess. (2) The physiography of the podolian loess and the problem of its stratigraphy. J. LATKOWSKI and MLLE. B. CHARLAMPOWICZ: The biological action of short waves ($\lambda = 6$ m.). Physico-chemical and morphological researches on the influence of short waves on the composition of the blood. The modifications observed are attributed to the rise of temperature produced in the blood of the animals examined. S. KÉLER: *Hordahlemia*, a new species of the genus *Mallophaga*. H. LICHE: Contributions to the ethology of the Dermestes (Coleoptera). MLLE. J. ACKERMANN: (1) Methodical researches on the determination of lipids in the organs of animals. (2) Experimental histochemical researches on the metabolism of lecithine in the animal organism. The absorption of lecithine in the intestine.

### MOSCOW

Academy of Sciences, *C.R.*, 1, No. 4, 1936. J. A. MINDLIN: Expansion of any function into a Schlömilch series. A. POLAK: Open expressions and stable transformations. Z. SUBIKOVA: Generalised linear differential systems. N. MOISSEJEV: Unessential character of one of the limitations imposed on topographical systems in Liapunov's theory of stability. K. M. KOSONOGOVA: A new method of photography. The new process is based on the combined action of light and electrochemical polarisation. P. PAVINSKIJ: Heisenberg's oscillator model and nuclear momenta. D. AVADALIAN: Exothermic transformations of aluminium oxide. A. J. CHARIT and N. V. CHAUSTOV: Flavins and metabolism (4). Flavin content in the liver of cattle during different seasons. M. MITZKEVICH: Stimulating action of 'catabolists' on the regeneration of the extremities in *Triton cristatus* and *Amblystoma tigrinum*. H. FRIESEN: Cosmic rays and mutations. No increase in mutations was observed in *Drosophila* exposed to cosmic rays of great intensity during the stratosphere ascent to the altitude of 15,900 m. (see also NATURE of May 23, p. 870). P. A. SCHWARZ and S. F. KUZMIN: Investigation of the potato in its genetic aspect. (1) Protein content of certain species and hybrids of potato. J. M. URANOWSKY: Determination of the longitudinal axis of extremities in the transplantation of regeneration buds in a late stage.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Monday, June 15

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Miss Mary Doveton: "Economic Geography of Swaziland".
A. Geddes: "Population Maps of Bengal".

### Tuesday, June 16

EUGENICS SOCIETY, at 5.15.—(at the Linnean Society, Burlington House, Piccadilly, W.1).—Dr. R. B. Cattell: "Is National Intelligence Declining?"*

ROYAL STATISTICAL SOCIETY, at 5.15.—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Prof. Major Greenwood, F.R.S.: "English Death Rates, Past, Present and Future" (Valedictory Address as President).

INSTITUTION OF CIVIL ENGINEERS, at 6.—Asa W. K. Billings: "Water Power in Brazil, with Special Reference to the São Paulo Development" (Special Lecture).

### Wednesday, June 17

ROYAL METEOROLOGICAL SOCIETY, at 5.—Discussion on "Thunderstorm Researches" to be opened by Prof. T. H. Laby, F.R.S.

### Thursday, June 18

ROYAL SOCIETY, at 4.30.—Dr. F. H. A. Marshall, F.R.S.: "Sexual Periodicity and the Causes which Determine it" (Croonian Lecture).

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INSTITUTION OF ELECTRICAL ENGINEERS, June 15–20. Summer Meeting to be held in Glasgow and the West of Scotland.

## Official Publications Received

### Great Britain and Ireland

The Institution of Professional Civil Servants. Annual Report of Council for the Year 1935. Pp. xiv+46. (London: Institution of Professional Civil Servants.) [185

Proceedings of the Royal Irish Academy. Vol. 43, Section B, No. 1: The Pigment of the Flowering Currant (*Ribes sanguineum*), varieties *Splendens* and *Atrosanguineum*. By Dr. Thomas J. Nolan and Thomas G. Brady. Pp. 12. 1*s*. Vol. 43, Section B, No. 2: A Note on Dalradian Pillow Lavas, Strabane, Co. Tyrone. By Dr. William J. McCallien. Pp. 13–22+1 plate. 1*s*. Vol. 43, Section B, Nos. 3 and 4: The Physiological Basis of the Sensation of Cold; iv. An Analysis of the Influence of Temperature and of Thyroid Extract on the Oxygen Consumption of the Anaesthetised Rabbit; v. The Relation between Basal Metabolism, the Regulation of Temperature and the Sensation of Cold. By J. M. O'Connor. Pp. 23–42. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [185

The Carnegie United Kingdom Trust. Twenty-second Annual Report, January–December 1935, approved by the Trustees at their General Meeting held on Friday, March 6th, 1936. Pp. vi+103+4 plates. (Dunfermline: Carnegie United Kingdom Trust.) [195

### Other Countries

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 15, No. 4: Die Während der schwedischen Expedition nach Spitsbergen 1898 und nach Grönland 1899 eingesammelten Harpacticiden. Von Karl Lang. Pp. 55. Serien 3, Band 15, No. 5: Femte jämförelsen mellan Svenska Riksprorotyperna för metern och kilogrammet och mynt- och juste- ringsverkets huvudlikare. Av A. Grabe, T. Swensson och E. Walldow. Pp. 57. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [125

Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 15. Pp. vi+338. (Kraków: Państwowej Rady Ochrony Przyrody.) 7 zł. [155

Instituto Español de Oceanografía. Notas y Resúmenes, Serie 2, No. 86: Hidrografía del Estrecho de Gibraltar en Marzo de 1933 (Campañas del guardacostas *Xauen*). Por Prof. Rafael de Buen. Pp. 16. Notas y Resúmenes, Serie 2, No. 91: Caracteres oceanográficos del Estrecho de Gibraltar en 1934 (Campañas del *Xauen*). Por Prof. Rafael de Buen. Pp. 20. Trabajos, No. 14: Condiciones oceanográficas de la costa Catalana entre la frontera francesa y el Golfo de San Jorge (Campañas del *Xauen* en Marzo de 1933 y de 1934). Por Prof. Rafael de Buen y Francisco de P. Navarro. Pp. 47+1 plate. (Madrid: Instituto Español de Oceanografía.) [155

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# Training of Industrial Physicists

A SHORT time ago, a conference, arranged by the Institute of Physics, was held on the training of industrial physicists. An account of the meeting, by Prof. J. A. Crowther, honorary secretary of the Institute, appears in the May issue of the *Journal of Scientific Instruments*.

That such a conference should be thought necessary is a striking indication of the increased number of physicists now going into industry. That there should have been, on the industrial side, nearly as many different views as speakers, is, perhaps, evidence of the diversity of subjects with which industrial physicists are now dealing. An employer interested in the crystalline structure of metals quite naturally thinks that his physical staff should have had a different training from those who are going to undertake research in, say, the musical industries. There are, however, a certain number of features in the training, knowledge and the personal qualities of candidates for such industrial posts that most employers of experience will want.

In the first place, the young physicist should have a good honours degree in his subject, with adequate mathematics. It is risky to take a man for a research post immediately after graduation, as a good examinee is not necessarily good at research. About a year's experience in research at a university should give a better idea of his capabilities in this respect than any ordinary examination. He may even find research less attractive than he thought it would be, and seek to earn his living in other ways. Further, since personal qualities are very important in an industrial position, this research will afford the director of the laboratory a better opportunity to give suitable advice on the choice of a career.

A number of university teachers appear to be strongly in favour of graduates attending the university until the Ph.D. degree is obtained, the argument being that they are being trained in research. In the opinion of scientific industrialists, the time required for this is, *from the candidate's point of view*, rather wasteful. The earlier he goes into industry the sooner will he become acquainted with the properties of the materials with which he has to work; and if he is fortunate enough to be placed under the supervision of an experienced physicist, there is no reason why his training in research should not take place in the industrial laboratory. If he is going to a laboratory where he will have to rely on his own resources, more post-graduate research will be a great advantage.

An unsatisfactory consequence of spending three years in post-graduate research is that, instead of becoming broader in knowledge, a man is apt to become more and more of a specialist. It is very desirable that the post-graduate training should be designed to widen his range of interests. For example, he might be encouraged to learn some chemistry, and to write essays on some physical problems which would require reference to the original sources in foreign languages. Candidates fresh from the university appear to have had little practice in getting up a new subject without considerable help, and, in general, physicists are not so familiar with foreign languages as are chemists. Some day, it may be hoped, there will be at least one man on the physics staff of universities who will have had experience in commercial research, and may be able to encourage students to look for commercial applications of the knowledge they acquire.

Little of the very modern theoretical physics finds immediate application in industry, but it is essential that the young physicist should have a good knowledge of the older physics dealing with properties of matter ; this is usually a weakness. Again, he may know quite well the properties of thick lens systems, but he often knows little about the actual use of a microscope with high magnification, and he has probably not heard of the conditions for critical illumination ; in fact, his knowledge of microscopy usually ends with the use of a measuring microscope. He is often unacquainted with refractometers, and so neglects a test which is frequently useful. Lack of knowledge of this type is perhaps pardonable when it is remembered that experimental work in a graduate course is designed to elucidate physical principles rather than to obtain a quick result.

A thing that will surprise a scientifically trained man when he enters a works in one of the older industries or one not closely in touch with science, is the number of operations that are carried out without scientific control at each stage. To get this control is one of the present problems of commercial research. Further, it is found in commercial laboratories that a large number of tests are required for which there is no standard testing machine. For both these purposes new testing instruments will have to be devised. The average post-graduate is not very successful at this class of work, probably because his post-graduate reading has been too much concerned with theory. More time should be given to reading the *Journal of Scientific Instruments* and similar journals, which give many hints on the design of testing apparatus, and the most suitable materials to use in its construction. Coupled with this should go instruction in machine drawing. It is perhaps too much to ask that the student should also attend classes in machine construction and design, but he should certainly do so after taking a post. There is considerable evidence that in the early stages of development of a process, a physicist with a little knowledge of engineering is better than an engineer with little knowledge of physics.

It was rightly remarked at the Conference that the personality of the industrial research worker is as important as his university training ; and because of this there are many good physicists who will never reach high administrative positions. The ability to communicate ideas and plans to employers (probably unscientific men) in non-technical language, and, having gained their assent to these schemes, to overcome the inertia and gain the goodwill of the works managers and the workmen, is essential.

The research worker is among the most intelligent of the employees, and he should be able and willing to go outside physics altogether on occasion. For example, he should be able to suggest selling points to the sales organisation, and even to the advertising staff. Last, but not least, an industrial physicist must be able to apply results of research to commercial use. To be able to visualise practical developments of scientific research is a gift which does not seem to be created by training, but it is one to be cultivated by every physicist who hopes to occupy a leading position in an industrial works.

# The Pattern of Culture

**The Fear of the Dead in Primitive Religion**
By Sir James George Frazer. Vol. 3. Pp. x+323. (London : Macmillan and Co., Ltd., 1936.) 10*s*. 6*d*. net.

NO linguist would think of picking words from a variety of languages none of which he had studied as a whole, and on these pickings base a theory of language. Every linguist knows that structure and function are essential to an understanding of speech. What is impossible in language is still possible in the study of customs and beliefs.

To take an example. It is a widespread custom to avoid noise, or even to observe complete silence, after a death. Does the anthropologist study thoroughly a few cultures of which this custom is an element in order to determine its relations to other elements ? No, he is quite content to collect instances from all over the world, and then to suggest whatever motive his imagination may prompt. In Indonesia his imagination is assisted by the opinion of one whom Sir James Frazer considers "the highest living authority" on that archipelago. That authority thinks complete silence is observed after a death in order "that no

sound should meet the ear of the soul to indicate the way to its home". It is a case of that deception which Sir James believes "primitives" generally are fond of practising on their dead.

Unfortunately, we are not told on what evidence this opinion is based. The magic word 'authority' is supposed to silence all doubts. Well, we shall not question the authority, in order to give Sir James's method every chance. We shall even assume that the opinion is based on the best possible evidence, the clear unequivocal statements of the Indonesians themselves. That is giving the method a very fair start, since in the end the explanations of the natives concerning their own customs must be the foundation on which our theories are built.

That does not mean that we are to accept the first explanation a native gives as the origin of the custom; for another native will give a different one, and as we go round the world we shall hear a dozen explanations or more given of the same custom. They cannot all represent the original reason. In this particular case we, for example, explain our 'two minute silence' as an expression of respect for the dead and an occasion for remembering them; and what is more, we do use the silence for that purpose. Why should the Indonesian explanation represent the original rather than ours, which Sir James does not even mention?

That reason must be the original one which fits all the facts. All the varieties of the custom and all the various reasons alleged must derive from it naturally so that at last we understand. Sir James's method unfortunately leaves out the most important and decisive fact of all, the place which custom occupies in the general scheme of culture.

To ask for the whole of Indonesian *culture* is to ask for a lot; but we should not be unreasonable if we asked to know something of Indonesian *ritual* as a whole. As we are not vouchsafed that much, we cannot test Sir James's method on his own material; we must fall back on a people whose culture we do know in detail. The Fijians forbid all noise after a death. They give no reason, but they suggest a theory in their technical term for this quiescence: they call it "abiding as *ilolokù*". Now *ilolokù* is used of suttee, of self-mutilation at a death, of fine mats put in the grave, common boys circumcised with a noble boy, etc. They evidently look upon this quiescence as a fictitious dying to accompany the dead, or as an offering to the dead. The two interpretations are not mutually exclusive, for the truth is probably that they offer themselves up as companions who die with their lord. However, we are not here to explain the custom, but on a point of method, to show that a study of structure leads to conclusions quite inconsistent with Sir James's, and so we must go on to examine the ritual structure as a whole.

It very soon forces itself on our attention that all Fijian rituals have the same general structure, and that quiescence is just one member of that structure. Thus funerals and the king's installation follow much the same lines; quiescence is part of both, and the still watch in the house of the dead or of the new king is in both cases called *tonitoni*. The same quiescence turns up again in circumcision as part of the same pattern, and again in the priest's installation which the natives recognise as identical with that of a manslayer. Do the Fijians want by their silence to deceive the king, the priest, the manslayer, the neophyte? Any theory that would explain the quiescence in one case must explain it in all.

We cannot rule out the Fijians as abnormal; we are realising more and more how normal they are, as we find everywhere the same pattern running through all the varieties of ritual. Dr. H. G. Quaritch Wales has demonstrated it most clearly in the case of the royal ceremonies of Siam, first tonsure, coronation, funeral. We need not go outside our own sacraments.

Even the fragments offered us by Sir James have sometimes adhesions which point to a uniform and widespread pattern. Thus the quiescence lasts four days among the Bella-Coola, and we know that that mystic number four which extends all over North America, the Pacific, ancient India, and much of Africa, is connected with the four quarters. The four days' quiescence of the Bella-Coola and the Fijians, and of many others, thus links up with a cosmic doctrine in which the four quarters figure very largely, and it cannot be detached from that doctrine and treated as an isolated fact.

The idea of structure or pattern in culture began to germinate when field-workers undertook comprehensive surveys of particular cultures. Recently it has made great strides, as witness such works as "Myth and Ritual", "The Labyrinth", "Siamese State Ceremonies", "The Hero" and others. Prof. B. Malinowski has crusaded persistently against the fact isolated from its context, and its days are numbered. When Tylor first relied on the isolated fact there was little else to rely on. His method of instances has done good work. It gave us "Primitive Culture" and "The Golden Bough". It sometimes put us on the right scent, oftener on the wrong one, but it served a valuable purpose in that it made us learn by our failures what we lacked. We must be grateful for the valuable studies with which it has provided us, through the pen of the veteran anthropologist and philosopher, Sir James Frazer.

A. M. HOCART.

# Physiology of Plants

**Plant Physiology**
By Meirion Thomas. Pp. xii+494. (London: J. and A. Churchill, Ltd., 1935.) 15*s*.

A COMPREHENSIVE text-book on plant physiology has been lacking for too great a length of time, in view of the ever-increasing demand for well-trained botanists at home and especially in the Empire overseas. This demand for botanists and other biologists has gone unsatisfied for several years now, especially during the post-War years; but it is regrettable that, apart from a very few outstanding university and other departments, little attempt has been made to meet the situation. Sir Arthur Hill, in the report of the Third Imperial Botanical Conference held in London on August 28–30, 1935, shows that the authorities at the Royal Botanic Gardens, Kew, and also certain of the British Empire Governments, recognise this need for betterment in the training facilities offered to budding botanists. But naturally the changes that they suggest can only affect those young botanists who have already been through their preliminary academic training (see NATURE. Feb. 15, p. 268). Increased facilities for such preliminary training, and profound improvements in those already established, are sorely needed, especially in the universities, if the right type of man and woman is to be attracted to botany as a profession. The prospects for any ambitious candidate are good: but the opportunities for training, as compared with other branches of science, are gravely inadequate. The reasons are not far to seek, and one of them is the lack of text-books of the right type.

For this reason we welcomed Dr. Thomas's "Plant Physiology", and for the same reason we cannot suppress a slight feeling of disappointment. We grant the author's contention that "there is still room for several more [text-books] in which the subject is treated from different standpoints and with different objects in view", especially so far as plant physiology is concerned, but it is difficult to see where the different treatment and points of view lie in the work under notice. Our criticism is directed almost solely against the author's choice of subject matter. Naturally the exigencies of space preclude the treatment of the whole of the subject in any one text-book, and thus the author disarms criticism by pleading force of choice. But, unfortunately for the student, Dr. Thomas has selected those very aspects of plant physiology which have been chosen by other authors, and also has admittedly left out those branches of the subject which are scarcely dealt with in other English works and are very important from the point of view of those who wish eventually to make botany their profession. We refer chiefly to the physiology of development and other aspects of the nutrition and reproduction of the plant.

The biochemistry of the subject is excellent, but we would have wished to see it developed further in order to cater for those who desire to continue their studies and researches on foodstuffs and other plant products of economic value. Agricultural and horticultural botanists, too, are passed over. This is all the more disappointing since, in view of the way in which Dr. Thomas has dealt with the subject matter, we feel that an important gap would have been adequately filled in the most praiseworthy fashion had the final choice of material been determined more by the primary needs of the professional botanist, economic and otherwise, so much in request to-day both at home and abroad.

Having now aired our grievance with the author over the choice of material, a brief review of what has been chosen is necessary. The book is divided into four parts, namely: (1) protoplasm; (2) absorption, translocation, and elimination of water, solutes and gases (osmosis, soils, transpiration, translocation, gaseous exchange); (3) nutrition and metabolism (photosynthesis and respiration); (4) growth and movement. There are two appendixes, one on biochemistry and the other on physical chemistry. These are excellent surveys, as one would expect from an authority on chemical problems of plant physiology.

For university students, the discussion on protoplasm leaves nothing to be desired. Few books seem to give a clear but condensed account of our present-day knowledge of this important attribute of life, but Dr. Thomas has been successful in writing an intelligible account without wasting time and causing confusion with masses of irrelevant detail. This discussion leads up to an excellent survey of enzymes and enzymic action.

The chapter on permeability is of outstanding merit, since, in the reviewer's experience, this subject is one of the most difficult for students to grasp, yet Dr. Thomas has made it quite as lucid as any other topic in the book. The chapters on the various aspects of metabolism have obviously been written with meticulous care. No outstanding results of researches in this field have

been overlooked: this applies to the literature of the subject right up to the time of this book having gone to press. The discussion on growth and movement is undoubtedly one of the best, of this standard, we have read.

Following the text is a bibliography of 163 citations, including papers, etc., up to, and including, 1935. The reviewer can think of scarcely any outstanding works omitted from this list, which will prove a boon not only to students of botany but also to more advanced botanists. There are author and subject indexes.

Having read the book, the reviewer's original disappointment after glancing at the contents, becomes even more acute. Had this been a mediocre review of those branches of plant physiology chosen for discussion, then one would have felt relieved that the author had gone no further. But what has been written is first-rate. In fact, the reviewer cannot think of another textbook of this standard (at any rate, British or American) which is so well written and up to date. To the academic botanist, it may be said of this book that it genuinely satisfies a long-felt want. But the author offers little food for thought or encouragement to the economic botanist, agriculturist, horticulturist or chemist. One consolation, however, is that in Dr. Thomas has been found what is sorely needed—a trustworthy author for students of plant physiology. Our appetite has been whetted, and now we can only ask that Dr. Thomas will set to work and give us at any rate one more volume, dealing with the more economic aspects of plant physiology, and those other aspects of the subject having a more direct bearing on plants and their cultivation in relation to man.

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# Progress in Acoustics

**(1) Anecdotal History of the Science of Sound to the Beginning of the 20th Century**

By Prof. Dayton Clarence Miller. Pp. xii + 114 + 16 plates. (New York: The Macmillan Co., 1935.) 10*s*. 6*d*. net.

**(2) Klänge und Geräusche:**

Methoden und Ergebnisse der Klangforschung, Schallwahrnehmung, Grundlegende Fragen der Klangübertragung. Von Prof. Dr. Ferdinand Trendelenburg. Pp. viii + 235. (Berlin: Julius Springer, 1935.) 25.80 gold marks.

THE study of the history of physics is not popular among physicists, and fewer textbooks now use the historical method of presentation. But is lack of time or space the only factor? Admittedly the undergraduate must labour under the increasing bulk of physics, and the mature worker must in addition grapple with the tangle of inference, extrapolation and philosophy encountered in atomic physics. If theory be placed before fact and science be regarded as the pursuit of truth (in any philosophical sense), then the history of any branch of physics presents one long succession of human 'error'. In such circumstances the psychologist would not be surprised to find that the history of physics was an unpopular subject amongst practising physicists.

(1) Prof. Miller's book is an amplified version of an address given to the Acoustical Society of America and, unlike most histories, is short enough to be read in an evening. It succeeds well in its purpose of recording what seem to be the principal events in the progress of acoustics up to the beginning of the twentieth century. If the early workers lacked facilities, they certainly lacked nothing that ingenuity could provide. For example, one might have thought that the device of moving objects in a vacuum by using a magnet outside was quite modern. Yet in the earliest version of the bell *in vacuo* experiment which Prof. Miller could find, Kircher records in 1650, with diagram, how he struck the bell with an iron clapper by manipulating a "vigorous lodestone" outside the glass bulb. The lecturer who has tried to give an effective demonstration, with simple apparatus, of this experiment, can sympathise with the early workers. Kircher, the Italian Academy and Boyle, in his first attempt, all failed.

The book is so well filled that almost any page records some interesting fact, whether it be details of the most gigantic sound known, that of the Krakatoa volcanic explosion in 1883, which was heard nearly three thousand miles away and affected all barometers, or of unsolved problems of mathematical acoustics. "Strange as it may seem, there is not now any theoretical formula by which one can derive, without the aid of empirical information, the dimensions of an organ pipe which will give a specified tone". In the simplest of wind instruments, the flute, the difference between the 'theoretical' and the actual length of the tube is more than two inches!

(2) The profound influence of developments of technique in several branches of physics upon recent experimental studies in acoustics is strikingly

shown by the contents of the second book. By his work in the Berlin laboratories of Siemens, Dr. Trendelenburg is in close touch with practical problems. He has presented an excellent summary of all physical and some physiological aspects of sound. Methods of generation, detection, measurement, recording, transmission and propagation in and out of doors and the main results are given, together with some of the relevant mathematical formulæ. Quantitative data appear in about one half of the 150 illustrations.

There is no book in English giving so varied and so recent results, with so little repetition of material readily accessible in the excellent text-books now current. Noteworthy in the section on musical instruments is the reproduction of about seventy quantitative sound spectra from the work of Meyer and Buchmann. Some of the results show the well-known variation of tone quality with pitch and intensity of the note played. A nine-page section on electrical musical instruments includes details of the Nernst-Bechstein electrical piano as well as of the less musical electrical synthesisers of sounds.

Both books can be strongly recommended as supplementing the text-books with but little overlapping. Although both are short, they contain numerous references to more detailed and original sources, and the Trendelenburg volume is more up to date than any handbook.

Progress in acoustics has already helped physics by making severe demands upon mathematical and experimental technique. There are signs that in the future still greater help may be given. Already the idea that the pitch of a musical note is that of the lowest harmonic has had to be abandoned. Pitch is found to be a property of the complex whole (depending even on such a factor as intensity) and not necessarily inherent in any of the parts into which a complex note may be analysed. That all those properties of a whole, of interest to the physicist, may yet not be explicable in terms of properties of parts, is apt to savour too much of biology to find general favour in physics. But does it not fit some of the facts discovered in recent research in acoustics, and may not the same idea be of service also in other branches of physics?

W. H. GEORGE.

# A Tribute to Dr. R. R. Marett

**Custom is King:**
Essays presented to R. R. Marett on his Seventieth Birthday, June 13, 1936. Edited by L. H. Dudley Buxton. Pp. xiii+325+4 plates. (London: Hutchinson's Scientific and Technical Publications, 1936.) 12*s*. 6*d*. net.

IN this volume, in which Dr. Marett's friends and former pupils have united to express their affectionate esteem on the occasion of his seventieth birthday (see page 1023), there are nineteen contributions. There are not more only because anthropologists are notorious wanderers, and Dr. Marett's friends are scattered over the four quarters of the globe. Enough have been accessible, however, for a representative selection from those who have accompanied, or followed in, Dr. Marett's footsteps.

The volume opens with a graceful dedication in Latin verse, which, like the contribution from Prof. Henry Balfour, following immediately after, commemorates a friendship and association of long standing. Prof. Balfour, in tracing a cultural link between the Nagas of Assam and the peoples of Melanesia, makes use of a method of technological analysis in demonstrating the movements of cultural elements, which he has made peculiarly his own. A somewhat similar problem, though in a different context, and with greater emphasis on the ethnological side, is considered by Mr. Diamond Jenness of Ottawa, in his essay on the prehistory of the Canadian Indians. In the course of a closely reasoned argument, he puts forward an interesting suggestion as to the chronological position of Eskimo culture and as to the standing of the Caribou Eskimo, which has recently been under discussion. He is of the opinion that this eastern group is neither original nor degenerate, but is the product of a fusion of Eskimo and Indian elements.

Dr. Marett's ever-lively interest in living 'savages', as he loves to call them, is perhaps best reflected in Dr. R. S. Rattray's "Totemism and Blood-Groups", which, notwithstanding its title, is not concerned with physiology, but discusses the place and influence of the totem in West African society, and Dr. E. E. Evans-Pritchard's "Daily Life of the Nuer in Dry Season Canp". In both of these, though indirectly, may be discerned the effects of Dr. Marett's guidance in directing attention to the practical interest of anthropological studies for the administrator. Mr. A. M. Hocart's witty discussion of the influence of "Snobbery" suggests a new line of research.

Among the archæological papers, mention can be made of no more than two—Prof. R. M. Dawkins's study of the activities and character of the Norsemen in the service of Byzantium, and the results of Mr. O. G. S. Crawford's detective zeal in tracing early routes to and from Ireland.

**Factor Table giving the Complete Decomposition of all Numbers less than 100,000**

Prepared independently by J. Peters, A. Lodge and E. J. Ternouth, E. Gifford, and collated by the British Association Committee for the Calculation of Mathematical Tables. Pp. xv + 292. (British Association for the Advancement of Science Mathematical Tables, Vol. 5.) (London: British Association, 1935.) 20s. net.

THE theory of numbers, going back at least as far as the time of Pythagoras, differs in many respects from other branches of mathematics, a fact that may explain the attraction of the subject, not only for the majority of mathematicians (though a minority dislike it intensely), but also for enthusiastic amateurs such as the late Lieut.-Col. A. J. C. Cunningham, whose generous bequest has made possible the production of this and two preceding volumes of British Association tables.

No other mathematical subject comes so near to being a science of observation and description, and the data to be observed are largely connected with factorisation of numbers. The study of congruences, quadratic and power residues, continued fractions, quadratic forms, and other more recent theories have arisen as by-products in the process of factorisation. The systematic treatment of the problem may be said to have started with Eratosthenes in the third century B.C., but the first extensive factor table was published by Brancker in 1668. Others were published by Chernac (1811), Barlow (1814), Inghirami (1832), Vega (1849), Hinkley (1853), Jones (4th ed., 1893), and Gifford (1931), while there also exist some of much greater range, notably Lehmer's "Factor Table for the First Ten Millions" (1909).

The great defect of factor tables is their liability to contain errors, which are not only more difficult to detect than is the case with tables of the ordinary continuous mathematical functions, but also more serious in their consequences. The present table rests on the comparison of three tables prepared independently by Prof. J. Peters, Prof. A. Lodge and Miss E. J. Ternouth, and Mrs. E. Gifford, assisted by no less than eighteen volunteer proof-readers. It may not be in mortals to command accuracy, but in any event the authors deserve it. The whole of the work of computers and readers has been voluntary, and the cost of production consists entirely of that of organisation and printing. H. T. H. P.

**The Beginnings of Systematic Bibliography**

By Theodore Besterman. Pp. xi + 81 + 12 plates. (London: Oxford University Press, 1935.) 21s. net.

THIS beautifully printed and illustrated work forms the third of a series known as the Oxford Books on Bibliography. In Part 1, Mr. Besterman traces the development of systematic bibliography from its earliest beginnings to the end of the seventeenth century. Bibliographies of very limited scope are shown to have existed before the invention of printing. In the second century, for example, Galen composed a classified list of his own very numerous writings, which was afterwards printed (1525). The greatest of early bibliographers was Conrad Gesner, but Mr. Besterman deprives him of the title of 'father of bibliography'. This honour, previously accorded to him by some authors, he awards to Johann Trithoim, who published at Basle in 1494 a bibliography listing some 7,000 works, mainly ecclesiastical. To Gesner still belongs the credit of being the first universal bibliographer, and a chapter is devoted to a description of this author's bibliographical works. It is interesting to note that in his "Pandectarum sive partitionum universalium" (Zurich, 1548), in which the books listed are classified by subjects, works of scientific interest have been separated under headings such as geometry and optics, astronomy, natural philosophy, etc. Gesner's bibliographies were restricted to works in the learned languages, Greek, Latin and Hebrew.

In subsequent chapters Mr. Besterman discusses particularly the evolution of national and subject bibliographies. One of the earliest known subject bibliographies is Symphorien Champier's "De medecine claris scriptoribus" (Lyons, 1506). This is the first medical bibliography, and lists works in European, as well as classical, languages. Pierre Borel's "Bibliotheca Chimica" (Paris, 1654), the first chemical bibliography, perhaps deserves to have received a mention.

Part 2 consists of a list of all important bibliographies published up to the end of the sixteenth century.

Mr. Besterman's scholarly work will appeal to all bibliophiles, and may not be without practical value to those whose researches lead them into the bypaths of sixteenth and seventeenth century literature.

**In the Heart of Europe:**

Life in Czechoslovakia. By Dr. Gerald Druce. Pp. 228 + 30 plates. (London: George Allen and Unwin, Ltd., 1936.) 6s. net.

THIS recent addition to the already numerous works on Czechoslovakia attempts to combine a general account of the country with guide-book details intended to help the tourist. Too much space is wasted by such statements as "life in provincial towns is naturally quieter than in the capital . . . it need not, however, be dull". A chapter is devoted to education, science, religion and art, fourteen pages being given to science. The influence of the exiled Komensky (Comenius) on the formation of the Royal Society in England and on contemporary American thought is recalled; the Czech origin of Purkyně and Mendel is naturally recorded, and many of the leading names of the present day and the last century are mentioned. But the information concerning their contributions to knowledge is too casually expressed to have much value. Thus one man of science has "added greatly to our knowledge of the useful and harmful bacteria"; another's special study "will eventually prove of value both to industry and to science itself", whilst a third "made many contributions to technological methods". Apart from the Frenchman Barrande, the only geologist selected for mention is Slavík. The volume has an excellent map prepared by the military cartographical institute of Prague. L. D. S.

**Modern Sociologists**

(1) Tylor. By Dr. R. R. Marett. Pp. 220. (2) Pareto. By Franz Borkenau. Pp. 219. (London: Chapman and Hall, Ltd., 1936.) 6*s.* net each.

THESE two little books inaugurate a series under the editorship of Prof. M. Ginsberg and Mr. Alexander Farquharson, in which the contributions to sociology of the more important of modern thinkers will be set out for the use of students and the benefit of a wider public. The first two volumes should be read together, not only for the contrast in the character and careers of the two men with whom they deal, but also for the insight they afford into the diverse ways in which modern sociological theories have come into being.

(1) Dr. Marett writes of Tylor and his work with the close and intimate sympathy of personal friendship and an association in anthropological studies lasting over many years. Without losing sight of the special purpose of the series of which his book forms part, he has produced the best account of Tylor's achievement that has yet appeared. It will serve to correct numerous misapprehensions that have arisen from the strictures of less thoroughly informed critics.

(2) Pareto stands in a different category from Tylor, though he too ended his life as the occupant of a professorial chair. His early and formative years, however, were passed as a man of action. He was an engineer in the service of the Italian Government until his political views and activities made it necessary for him to relinquish his official position. He seems to have been most strongly influenced by his antagonism to the views of Mazzini, of whom his father had been a supporter in the revolutionary movement. Hence, whereas Tylor's contribution to sociological thought is an integral part of a theory of the development of culture as a whole, Pareto's sociological theory seems to emerge from an opposition to humanitarian liberalism and the trend of Italian politics rather than from a general philosophical position which determined his outlook. His doctrine of the place of force in the State finds its embodiment in Mussolini; but his death took place before this had become fully apparent.

**Exotic Aquarium Fishes:**

a Work of General Reference. By William T. Innes. Pp. 464. (Philadelphia: Innes Publishing Co., 1935.) 5 dollars.

IT will certainly surprise most readers to learn that there are about sixty flourishing aquarium societies in North America, and that there is a well-organised trade in about three hundred species of fresh-water fish. These are brought mainly from the tropics, where the fish are more brilliant in colour and often of bizarre shape. Here these fish are nearly all represented by photographs, many of them coloured. The fish are properly classified and named, and under each there is a description of the fish with an account of its spawning and its food and a note as to the temperature required. There are often practical hints as to keeping it in health and in some cases as to line breeding. This systematic part is preceded by a discussion of the primary principles, namely, sufficient oxygen, enough light, right temperature and correct feeding. There are directions as to prepared food and the collecting of such live foods as *Daphnia*, mosquito larvæ, *Tubifex* and various other forms, together with the culturing of enchytræids and infusorians. Then follow the enemies of fish—water beetles, dragon-fly larvæ, *Hydra*, various other insects and *Argulus*.

Of diseases and parasites there are far fewer in aquaria than in Nature. The chief troubles are a parasitic protozoon (*Ichthyophthirius*), which burrows into the skin and later gives entrance to fungus, and a fluke (*Gyrodactylus*), for both of which remedies are suggested. Various molluscs and crustaceans are valuable scavengers in aquaria, but the success of these largely depends on the proper growth of plants, of which there is a valuable account. The book is not intended for the professional zoologist; but it will be found of great value in his reference library.

**Organic Syntheses:**

an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. John R. Johnson, Editor-in-Chief. Vol. 16. Pp. v+104. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 8*s.* 6*d.* net.

THE latest addition to this series maintains a high standard of efficiency and utility. It contains details of twenty-eight preparations, together with three pages of later references to matter appearing in earlier volumes. The index covers vols. 10–16.

1,4-Diphenylbutadiene is prepared by the condensation of phenylacetic acid and cinnamic aldehyde, in presence of acetic anhydride and litharge. A somewhat similar condensation of phenylacetic acid and glacial acetic acid in presence of a thorium oxide catalyst, yielding methyl benzyl ketone, is accomplished at 430°–450° in a neat electrically heated furnace, figured in the text. Methylhydrazine sulphate is made by the action of dimethyl sulphate on benzalazine (prepared from benzaldehyde, hydrazine sulphate and aqueous ammonia), the other products being the recovered benzaldehyde and methyl alcohol. In recrystallising that useful reagent, *p*-nitrobenzyl bromide, from ligroin, the inverted filtration method of Bost and Constable (figured in the text) is recommended, since it reduces the fire hazard and facilitates the manipulation of the lachrymatory solution.

Quinone is prepared in a yield of 92–96 per cent by oxidising hydroquinone at 40° with sodium chlorate in presence of dilute sulphuric acid and a little vanadium pentoxide. Furan is hydrogenated almost quantitatively to tetrahydrofuran (tetramethylene oxide) in presence of a palladous oxide catalyst, of which the preparation is described. Among other interesting preparations included are β-alanine, epichloro- and epibromo-hydrin, *n*-hexaldehyde, the two dimethylhydrazines (as hydrochloride), and *sym.*-trithiane.

J. R.

# Transportation of the 200-inch Mirror

THE manufacture of the Pyrex disk for the 200-inch reflecting telescope of the California Institute of Technology is one of the most notable technical feats of this decade. A detailed description of the manufacture and annealing has already appeared as a Supplement to NATURE (February 8, 1936), and we have now received from Dr. G. E. Hale the following description of the transportation of the giant disk from Corning, N.Y., to Pasadena, California, where the mirror will be ground, polished and figured.

"The 200-inch disk was packed with great care at Corning and mounted within a heavy steel case in a special low car, built for the long trip across the continent by the New York Central Railroad. The operation of packing and transportation was a delicate one,

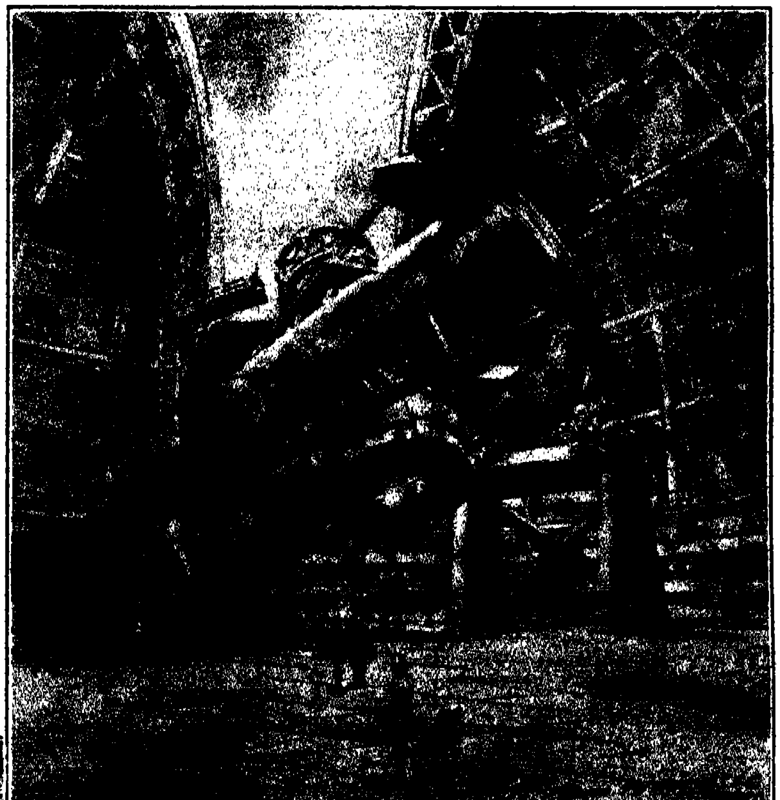

FIG. 1. Tentative sketch of the 200-inch reflecting telescope. This design may be altered in several respects before construction.

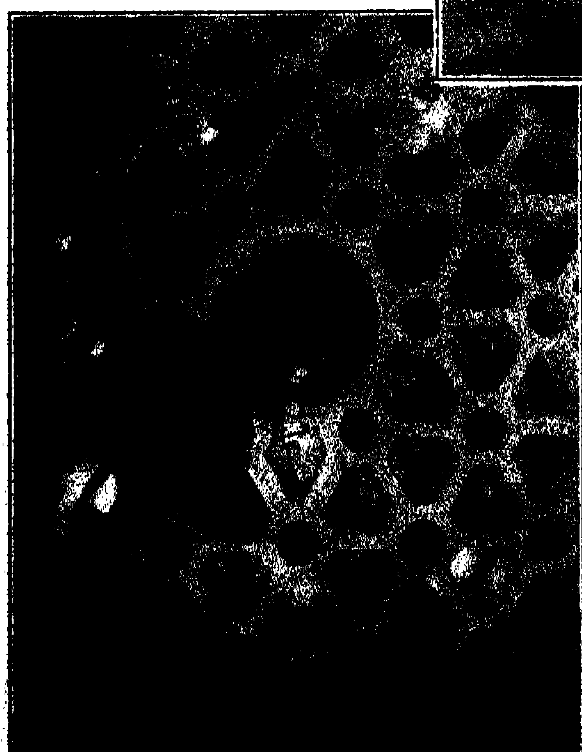

FIG. 2. Dr. McCauley testing the 200-inch disk with polarised light at the Corning Glass Works.

as the base of the steel covering cleared the roadbed by only a few inches, while its upper extremity came within three or four inches of various tunnels and bridges on the route. A special train of three cars and a locomotive was provided, and this proceeded at the rate of 25 miles per hour over the New York Central, the Chicago, Burlington and Quincy, and the Atcheson, Topeka and Santa Fé systems from the glass works at Corning, N.Y., to Pasadena. The train moved only by day, with an advance scout, and all vibrations were automatically recorded. The paper record is remarkably smooth, and it was no surprise to find the large disk in perfect condition when opened in the optical shop of the California Institute. Ordinary visual tests, supplemented by observations through various parts of the disk and its rib system in polarised light, indicate the perfection of the annealing process conducted at Corning.

"To an old-timer like myself it is difficult to realise, when looking at the new disk, that the central hole has an aperture equal to that of the

40-inch Yerkes refractor. No other scale gauge could be more striking to me, as I recall so vividly the arrival of the 40-inch objective at the Yerkes Observatory in 1897. Contrasted with our previous refractors, it greatly excited our anticipations, and our hopes of good performance have not been disappointed during the intervening years."

The accompanying illustrations show (Fig. 1) a tentative sketch of the complete 200-inch reflecting telescope, and (Fig. 2) Dr. McCauley testing the great disk with polarised light at the Corning glass works. The design shown in Fig. 1 may be altered in several respects before construction takes place.

# British Chemical Plant Exhibition

ON Monday next, June 22, the Right Hon. J. Ramsay Macdonald is to open an exhibition of British Chemical Plant at the Central Hall, Westminster, S.W.1. This exhibition, which has been organised by the British Chemical Plant Manufacturers' Association, will occupy the ground floor and basement of the Central Hall, and will run concurrently with the Chemical Engineering Congress of the World Power Conference, which is meeting in the same building from 9.30 a.m. until 6.30 p.m. on June 22–27 and until 8 p.m. on June 23 and 26.

Although the British Chemical Plant Manufacturers' Association has sponsored this exhibition, the management committee has wisely given firms not members of the Association an opportunity of displaying their manufactures. One condition, however, has been imposed on all exhibitors, namely, that all plant exhibited shall be of British manufacture, the criterion laid down being that at least 75 per cent of the cost of the plant shall represent labour or material within Great Britain or the Empire.

The last exhibition organised by this Association was held in 1931, so that those who are attending this, the first international conference on chemical engineering, may be able to observe the rapid progress made within five years. To others who are not intimately acquainted with chemical engineering, the exhibition should provide an admirable illustration of the scope of the subject and the complexity of the plants which may have to be used when a laboratory experiment or research has to be developed into an industrial process.

Of the forty-eight firms which are exhibiting, thirty have declared that a number of exhibits which they are showing, amounting to a hundred in all, have not been shown by them at any previous British chemical plant exhibition.

Materials of construction being of outstanding importance to the chemical engineer, it is not surprising to find that this aspect of the subject has received considerable attention, both from the research associations working in close alliance with the Department of Scientific and Industrial Research, as well as commercial enterprises. Numerous exhibits are therefore to be found throughout the stands of the exhibition which deal with the improvements in the cast irons now available, developments which have taken place in steels designed to resist corrosion or withstand high temperatures, the protection of steel by glass, enamels, or other metals.

Owing, for example, to the tendency to intergranular corrosions in austenitic stainless steels, after they have been heated to a dull red heat, the welding of such steels into chemical plant having dimensions greater than the internal dimensions of the heat treatment furnace could only be done at the expense of the corrosive resistance properties of the welds. Research in this field, however, has shown that the addition of silicon to such a chromium nickel steel not only eliminates the necessity for the heat treatment of the welded joints, thus removing the limitations to the size of vessel which could be manufactured and still retain its resistant qualities, but also that this type of steel increases the resistance to attack by various acids, and oxidation at high temperatures. Examples of vessels made from this type of steel as well as various types of welding and cutting equipment are on view in the industrial section of the exhibition.

Research has not been idle in connexion with the non-ferrous metals and their alloys, whilst a considerable amount of development has also taken place in refractory and ceramic materials, possibly accelerated by the extended use of metals or alloys possessing high corrosive resisting properties. Here again is ample illustration of the progress which has been effected by the typical pieces of chemical plant to be seen on the various stands in the exhibition.

The National Physical Laboratory and kindred associations have been interested in the problem

of heat transmission, the properties of steels when at a high temperature and the behaviour of steels in the presence of superheated steam, some or all of which have a direct bearing on the design of high-pressure autoclaves, forced circulation evaporators, rotary economisers, heat exchangers, high vacuum distillation plants, band and drum dryers. Many pieces of apparatus of this character are to be found on various stands.

Still taking the exhibit organised by the Department of Scientific and Industrial Research, which will be found in a separate room in the north-east corner of the ground floor, as the key to the exhibition, it will be found that there is a number of exhibits which illustrate the work being carried on at the Fuel Research Station in connexion with the coal survey, carbonisation of coal, pulverisation of fuel and hydrogenation-cracking of tar, and on passing into the industrial section, models can be seen of a carburetted water-gas plant and a waterless gas holder, as well as a small coal water-gas plant and appliances for using gas such as burners, gas-fired boiler and oil heaters. The pulverisation of coal naturally directs attention to the size-reduction machinery on view on several of the stands, but as crushing and grinding machines in industry usually have large outputs and therefore are of large size, models in some instances have been installed to illustrate the type and action of the firm's make of machine. After size-reduction has been completed, the broken pieces are usually separated either according to size or composition, and again the visitor will note on several stands screening devices of the latest types.

Where the problem facing the chemical engineer is to obtain hydrogen in a pure state suitable for hydrogenation processes, a visit to the exhibition will show him some of the latest developments in the cells used in the electrolytic production of hydrogen and oxygen from water. The juxtaposition of this stand and the welding stand serves to remind the visitor that the oxygen produced by the electrolysis need not as formerly constitute an industrial waste, but may be readily used as one of his raw materials by the welder.

Since the problem of separation arises in mixtures where the components forming the mixture can exist in the same or different states of matter, the types of plant designed for separation problems are very varied. In the exhibition are numerous examples of equipment intended for the separation of mixtures of solids and liquids, such as filters and filter parts ranging from the sterilising type where the solid content is extremely small to the various types designed to separate thick slurries, centrifugal machines, classifiers, flocculators and thickeners. Industrially, many of these machines are of considerable size and would therefore be too large for exhibition purposes, but the firms desirous of making a representative display have in such cases provided small-scale equipment, models, spare parts or other means of illustrating the types of plants they supply and their operation.

The converse problem, namely, mixing solid with solid, or solid with liquid, or liquid with liquid, is of equal importance in the chemical industry, and on various stands throughout the exhibition a variety of types of plant which have been developed for this purpose can be studied.

An important problem in chemical works is often the movement of large quantities of material, for the chemical engineer has not only to consider the physical and chemical properties of the substance to be moved but also, as in all other operations, the efficiency with which it is carried out, so that the cost of the final product may not be unduly raised. It is, therefore, not surprising that on many stands in this exhibition will be found examples of pumps, valves, pipe-lines and so on, many of which have been specially designed and constructed for use in factories where corrosive liquids or liquids containing large percentages of solid matter have to be transported. On the other hand, the aim of the designer has sometimes been to produce a reliable machine suitable for the food industry, where no form of contamination by lubricants or other means can be tolerated.

Efficiency being the watch-word in modern industry, it is pleasing to observe that in the present exhibition this factor has not been overlooked, but that there is on view apparatus for measuring temperature, pressure, humidity, controllers and recorders, various types of meters for the measurement of air and gas, steam and liquids as well as recorders for *p*H values and such checks as can be made by colour comparisons.

Moving about in the industrial section, one sees how closely the work of the various research associations is being studied and followed by the plant manufacturer.

The Chemical Works Regulations of 1922 contain rules relating to the equipment to be provided and used by anyone entering a chamber containing poisonous material and so on, and even this section of the equipment of a chemical factory is well represented at the exhibition. Another group of stands of interest to those concerned with chemistry, chemical engineering or chemical industry contains the literature available, both books and periodicals.

There is much of interest in the exhibition to everyone associated with chemical industry, so that it seems a pity that members attending the Congress will only be able to visit the exhibition during intervals between the meetings upstairs.

# Fuel Research in Great Britain

NEARLY five hundred guests visited the Fuel Research Station at East Greenwich on June 9. They were received by the Director of Fuel Research (Dr. F. S. Sinnatt). The plant and laboratories were open to inspection and the work in progress was explained by members of the staff.

The Lancashire boiler was seen in operation using a pulverised fuel burner and distributor designed at the Station. The boiler (25 ft. × 7 ft. 6 in.) is rated at 5,000 lb. of steam per hour, but was working smoothly and without difficulty at an overload of 100 per cent. Commercial users of these appliances have found that they enable greatly increased loads to be maintained steadily for long periods. The distributor, which enables a heterogeneous stream of material to be divided into two equal parts, was first shown last year, and has since been successfully applied in a number of industrial plants. A Scotch marine boiler has just been installed for examining bunker coals under conditions comparable with those prevailing at sea, and also for trying out alternative methods of firing.

The cleaning and grading of coal at the colliery before it is placed in the market is a practice that has extended greatly in recent years. A detailed study is being made at the Station of the effects of moisture in fine coal on treatments such as dedusting, screening and dry cleaning. The use of flocculating agents for promoting rapid settlement of suspended solids in washery circulating systems is now an accepted practice, but work is proceeding to try to elucidate the actual mechanics of the processes involved and to determine the best way of applying these flocculating agents. Special attention is being given to coal breaking. The coal industry is beginning to experience certain difficulties owing to the diminished demand for large coal and the increased demand for graded sizes. Tests carried out under the direction of Survey officers are proceeding in certain coal fields with the view of providing data regarding the breaking properties of seams and the relative value of various types of breakers. The Fuel Research Station is co-operating particularly in assessing the stability of breaker products when subjected to transport and handling.

The carbonising plant at the Station includes a setting of horizontal gas retorts of the type that are in use for carbonising between seven and eight million tons of coal a year in the gas works of Great Britain. In retorts of this type, steaming of the charges of coal has not normally been practised. Investigations carried out in the horizontal retorts at the Fuel Research Station have shown that by a special method of steaming during the later hours of the carbonisation period, the output of gas can be increased by about 10 therms per ton of coal or about 14 per cent above normal. During this investigation, one retort of the setting of eight has been isolated to allow of accurate determinations of the extent of steam decomposition when different rates of steam supply have been used. The fundamental aspects of the steaming process have received special attention during the work, which is now almost completed.

The greatest interest is being taken in the low temperature carbonisation plant which has been developed at the Fuel Research Station. The hydrogenation programme is of importance in relation to the economical utilisation of the tar. The work done in the plant on British coal seams has shown that a very wide range of coals can be successfully treated. This is of the greatest use in considering the developments that are taking place in low temperature carbonisation. At least one setting of this type of retort developed at the Station is being operated commercially.

The intermittent vertical chamber ovens at the Station are being used in an investigation of the effects, on the coke produced, of blending weakly caking coal with strongly caking coal. One of the main objects of this work is to explore the possibility of extending the life of the supply of strongly caking coals in Great Britain. Series of blends are being carbonised at high temperatures and the conditions of carbonisation with each blend are adjusted so that the final rate of gas evolution at the end of the carbonisation period is as nearly constant as possible with each blend.

A process for the manufacture of active or absorbent carbon from sized coal has been worked out. It has been observed that the nature of the coal is a critical factor in the process and, up to the present, three coals have been found suitable for the purpose. The information for the identification of these coals has been provided by the Fuel Research Coal Survey, reinforced by special experiments on a small scale. Large amounts of the coals suitable for the process are available in the country. When the conditions required for converting coal into active carbon had been established on a small scale, the work was transferred to the large-scale plant at the Station. The sized coal was carbonised continuously in the narrow brick retorts developed at the Fuel Research Station, at

a temperature of 480° C. The low-temperature product obtained was activated by treatment with superheated steam at a temperature of 950° C. This second stage of the treatment was carried out in the same type of retort. The yield of active carbon was 20–25 per cent of the coal originally carbonised. Some of the active carbon sized to a grade from $\frac{1}{4}$–$\frac{1}{8}$ in. is being used at the Station for the recovery of spirit and benzole from coal gas.

The low-temperature carbonisation of coal produces large amounts of tar for which new industrial outlets are continually being sought. Similarly, the whole of the high-temperature tar produced in Great Britain does not always find a ready market. Processes such as hydrogenation-cracking which employ tars and tar distillates as raw materials for the production of fuel oils are therefore worthy of examination.

Experimental work has been in progress to determine the conditions and plant necessary for the conversion of tars and tar oils into materials, such as motor spirit, for which the market is relatively large. The process is one of hydrogenation-cracking and is operated under high pressures of hydrogen (normally about 200 atmospheres) and at elevated temperatures (350°–550° C.). The most satisfactory conditions and catalysts are being determined by experiment, and continuously operated plants are in use in which the variables of the process are being studied. The catalyst favoured at present for the treatment of crude low-temperature tars is a sulphide of molybdenum supported on a porous gel, but for selected oil distillates more active catalysts are available.

It has been found that low-temperature tar with no pre-treatment, other than filtration to remove dust, can be hydrogenated satisfactorily. In one passage through the supported molybdenum catalyst there is obtained a product which is free from pitch and which contains motor spirit amounting to 45 per cent of the tar treated. By re-processing the high-boiling oils the total yield of spirit becomes 76 per cent by weight of the tar and 100 per cent by volume. Tar fractions can be treated with greater ease than crude tar. Creosote, for example, is much more readily treated than high-temperature tar. The crude spirit requires very little refining to make it a stable water-clear motor spirit having satisfactory properties. It has a good anti-knock value (octane number 70–75).

The scale of operation of the process has been increased in stages, the latest development being the design and construction of a plant capable of dealing with 1–2 tons of raw material per day. In erecting this plant, two main tasks were undertaken. The first of these consisted in working out a technique or method of operation which should be applicable to a large-scale plant; the second entailed the examination of the effect of variables (temperature, pressure, through-put, etc.) with the view of determining the best working conditions for the treatment of various raw materials. The first task has been accomplished, and work on the second is in progress.

The Fuel Research Station is also the headquarters of the Physical and Chemical Survey of the National Coal Resources, which is examining the coal seams of Great Britain. Much interest was taken in samples which were exhibited to show the great diversity in the appearance and properties of different types of coal, and in the methods and apparatus used in their examination.

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# The Kiss Precise

FOR pairs of lips to kiss maybe
Involves no trigonometry.
'Tis not so when four circles kiss
Each one the other three.
To bring this off the four must be
As three in one or one in three.
If one in three, beyond a doubt
Each gets three kisses from without.
If three in one, then is that one
Thrice kissed internally.

Four circles to the kissing come.
The smaller are the benter.
The bend is just the inverse of
The distance from the centre.
Though their intrigue left Euclid dumb
There's now no need for rule of thumb.
Since zero bend's a dead straight line
And concave bends have minus sign,
*The sum of the squares of all four bends*
*Is half the square of their sum.*

To spy out spherical affairs
An oscular surveyor
Might find the task laborious,
The sphere is much the gayer,
And now besides the pair of pairs
A fifth sphere in the kissing shares.
Yet, signs and zero as before,
For each to kiss the other four
*The square of the sum of all five bends*
*Is thrice the sum of their squares.*

F. SODDY.

# Obituary

## Prof. Frank Cavers

PROF. FRANK CAVERS, whose premature death occurred on May 26, was educated as a botanist at the University of Leeds, under the stimulating influence of the late Prof. Miall, whose heuristic methods attracted much attention in the early years of the century. After leaving the University, Cavers held teaching posts in botany at Hartley College, Southampton, and later at the Goldsmiths' College in London. He was not, however, in all respects well fitted for such work, though he was an excellent botanist and a most lucid expositor of his subject, as was shown by a number of elementary text-books —models of their kind—written for the University Correspondence College. He made a special study of the Bryophyta, publishing the results of his admirable researches in the *Annals of Botany*, the *New Phytologist*, and elsewhere, and obtaining the D.Sc. degree of the University of London.

On leaving the teaching profession, Cavers decided to qualify as a medical man, and after a hard struggle and several set-backs, eventually obtained his qualification. This part of his career furnished striking evidence of Cavers' grit and persistence, for to pursue the medical curriculum is not the easiest of tasks many years after normal student days have been left behind, and the mind has long been running in other channels. Once qualified, he made a thorough success of his job, taking a panel and private practice in the north of London, working extremely hard, and in less than ten years saving enough money to enable him to retire.

Besides his research, Cavers rendered other services to science. For a short time he was assistant editor of the *New Phytologist*, and on the formation of the British Ecological Society in 1913—in which he played an important part—he became its first secretary, and edited the *Journal of Ecology* from 1913 until 1916. In this work he showed his conspicuous powers of masterly condensation and clear exposition. His abstracts of voluminous papers dealing with complicated material were about as good as they could be. The same gifts were later afforded ample scope during his editorship of the *Journal of Cancer Research*, which he undertook on his retirement from medical practice.

Cavers was an extremely hard, untiring worker and the most modest and unselfish of colleagues, always ready and willing to do his share, and more than his share, of the work in hand. He was also a pleasant companion with wide cultural interests—altogether a very lovable man. A. G. T.

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WE regret to announce the following deaths:

Prof. A. A. Bowman, professor of moral philosophy in the University of Glasgow, on June 12, aged fifty-three years.

Sir George Hadcock, K.B.E., F.R.S., director of Vickers-Armstrongs, Ltd., and of Armstrong Whitworth, on June 4, aged seventy-five years.

Prof. Charles A. King, principal of the Engineering College, and Jodhpur Hardinge professor of technology in the Benares Hindu University since 1919, on May 19.

# News and Views

### Total Solar Eclipse of June 19

BY the time this note appears in print, the parties stationed at various points on the long belt of totality will know whether atmospheric conditions have enabled them to carry out their eclipse programmes, or whether the many months of organisation and preparation have been in vain. Certain preliminary reports will, we hope, be available for publication in our next issue. An outline of the plans of the various expeditions was given in an article in NATURE of April 25, p. 685. Starting from Greece in south-eastern Europe, expeditions are stationed in Asia Minor, the Caucasus, at various places in Siberia, in Manchukuo and in Japan. One party sent by the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society, under the leadership of Prof. F. J. M. Stratton, has set up its apparatus at Hamishari in Hokkaido; the other British expedition, under Prof. J. A. Carroll, is at Omsk. We understand from Dr. T. Banachiewicz, of the Cracow Observatory, that four Polish expeditions are observing the eclipse, paying particular attention to Baily's beads; one is in Japan, at Tsubetsu, one in the region of Omsk, and two in Greece (one on the island of Chios and one in the vicinity of Athens). All four expeditions are using similar chrono-cinematographical instruments with neon tubes constructed at the Cracow Observatory. Prof. B. Gerasimovič, writing from the Eclipse Camp at Ak Boulak, near Orenburg, informs us that there are no less than twelve foreign parties and twenty-eight Soviet expeditions observing the eclipse from the U.S.S.R. The observing parties are stationed at Beloretchenskaya (North Caucasus), Ak Boulak (near Orenburg), Sara (near Orenburg), Kustanay, Omsk, Krasnojarsk and Botchkarevo (Far East). Prof. Gerasimovič has kindly undertaken to cable to NATURE a brief statement of results obtained from these stations, and we are also expecting to have a similar communication from Prof. Stratton.

**Presentation to Dr. R. R. Marett**

A VOLUME of anthropological essays by friends and former pupils, entitled "Custom is King", a notice of which appears on p. 1014, was presented to Dr. R. R. Marett, Rector of Exeter College, Oxford, and reader in social anthropology in that University, on June 13, to mark the occasion of his seventieth birthday. The presentation was made in the College Hall by an undergraduate, and was attended by the Vice-Chancellor, a number of heads of houses and professors. The chair was taken by Sir Charles Harper, a former pupil. In acknowledging the presentation, Dr. Marett reminded his hearers that, as the University had claimed three quarters of his time in his main business of philosophy, only one quarter had been available for the claims of anthropology, while his books had been written in vacation. In speaking of anthropology in the University of Oxford, he referred to the late Arthur Thomson and to Henry Balfour. With himself they had been 'three men in a boat', of whom it was possible to say that no one was captain; and to them had been added Dr. L. H. Dudley Buxton, and later Mr. T. K. Penniman, as cabin boys. In conclusion, he spoke of the termination of his long tenure of the readership in social anthropology, and rejoiced that Oxford at last was to have a full professorship in anthropology.

IT is scarcely necessary to recall how great is the debt of anthropology in Oxford to Dr. Marett. With the exception of Sir Edward Tylor, who of course stands apart from and above all, this branch of academic studies, perhaps, owes more to him than to any single individual—even though the great services of the late Arthur Thomson and Henry Balfour be not forgotten. Long before the contemplation of the manners and customs of 'savages' had been raised to the dignity of forming part of an official course, his lectures on ethics and psychology had directed many of his pupils to this pleasing intellectual adventure; and not only did he take a foremost part in the movement which led to the institution of a diploma in anthropology, but also, as secretary for twenty years of the committee responsible in the University for this subject, he imposed his broad and philosophic outlook on the Oxford school of anthropological thought.

**Plants and Medicine**

THE lecture which commemorates annually Sir Edwin Chadwick, "the father of English sanitation", was this year given at the Chelsea Physic Garden by Sir William Willcox on June 11. In choosing "Plant Pharmacology and Medical Practice" for his subject, Sir William might well have been excused from dealing with synthetic chemical medicaments; he nevertheless claimed as plant products "coal and coal tar with its myriads of derivatives", a claim which suggests a perilous affinity between rhubarb and the barbiturates. It seems a strong thing to hold, as Sir William Willcox is prepared to do, that "plant products rarely act as tissue poisons because of their purity . . . (while) in the chemical laboratory the conditions are so different from those obtaining in Nature that by-products injurious to health always occur during any chemical synthesis", and that "it is for this reason that so many of the modern artificially synthesised drugs are liver and tissue poisons: examples are cinchophen and similar derivatives". Nevertheless, it is certain that if in recent years orthodox medicine has preferred the synthetic product of the laboratory, the public have turned in increasing measure to herbal remedies, and there has been a large increase in the numbers of herbal stores and in the trade in herbal medicines. The benefit derived from drinking several pints of hot water daily in the form of a *tisane* or decoction may be substantial, and certainly the danger of positive harm is minute compared with the results of uncontrolled resort to the tonics, sleeping-draughts, digestive pills and headache tablets which are a by-product of modern civilisation. The representative exhibition of medicinal plants shown at the lecture served to link the Physic Garden of to-day with its beginnings in the seventeenth century, when it supplied the apothecaries of London with those herbs which they failed to collect on their 'herbarizing' expeditions in the fields of Greenwich and Battersea.

**English Death Rates**

THE retiring president of the Royal Statistical Society, Prof. Major Greenwood, took for the subject of his valedictory address, read on June 16, "English Death Rates, Past, Present and Future". Prof. Greenwood pointed out that down to the beginning of the twentieth century, there was no improvement in mortality at the beginning of life and little improvement in old age, but that since the turn of the century there had been great improvement in the mortality of little children and some improvement in old age. From the beginning of registration, rates of mortality at ages between early childhood and old age improved, but the improvement began in time with the earlier ages and seemed to pass like a wave down the ages. In the opinion of some students, this wave-like movement was determined by the course of social reform, first directed to the protection of the young and only later to that of adults; Farr attributed the slow improvement of the rates of mortality in his time to the growth of towns; in his view, the general social and hygienic reforms of his time were offset by the disadvantages of density of population. Modern students, notably Kermack, McKendrick and McKinlay, have objected that the wave of improvement is too regular to be explained in these ways and suggested that the prime factor regulating mortality rates is the environment of childhood. Prof. Greenwood concludes that, even if this hypothesis does not completely explain the whole movement, it furnishes an important element of truth, so that contemporary emphasis upon the paramount importance of caring for the young is properly placed. This does not, of course, lead to the pessimistic conclusion that measures directed to the improvement of the conditions of life of adults are useless; there is much evidence that they are of value. Thus, the

problem of cancer is not one which the general statistician can view with much pleasure, "but a perusal of clinical records and of the last report of the Director of the Imperial Cancer Research Fund gives some grounds for optimism".

### The Imperial Institute and Vegetable Fibres

WE are indebted to Dr. E. Goulding for an account of forty years of investigation of vegetable fibres at the Imperial Institute, which was the subject of the Mather Lecture delivered by him during the annual Conference of the Textile Institute on June 3–5 in London. A record such as this emphasises the importance and value of the Imperial Institute to the Empire as a whole. Individual technical reports go to all parts of the Empire, but usually each country is concerned only with those which emanate from itself. A comprehensive account of this work is therefore more than welcome, in that it gives an idea of the immense scope of inquiries which have been investigated and of which records and technical reports are available. In recent years, since the creation of the Advisory Councils of the Imperial Institute in 1926, the Scientific and Technical Department has had considerably more scope; for these Councils, of which there is one for vegetable fibres, may propose and consider schemes of work for prosecution by the Institute and may advise on the best means of carrying them out. As a result of this, one of the main lines of investigation in the case of vegetable fibres has been the effect of sea-water on the life of ropes and twines. This work was commenced primarily in the interests of the sisal industry, but has since been enlarged to include New Zealand flax, Mauritius hemp and sannhemp. The results of this work have proved to be of the greatest value both to the producer and to the consumer, and have done much to advertise the extremely useful services which the Imperial Institute performs.

### The Colorado Potato Beetle

THIS insect is a recent immigrant into Europe from North America, and has now become established over a large area of France. Its further spread into north-eastern France and into Belgium is a matter of importance to potato growers in England. The Ministry of Agriculture and Fisheries directs attention to the probability that examples of this beetle will reach southern England from time to time by direct flight. In such circumstances small outbreaks might readily occur, and the Ministry is accordingly anxious to obtain as early a notification as possible of the discovery of the pest in this country. Potato growers, especially those in Essex, Kent and Sussex, are asked to keep close watch on their crops, and to inform the Ministry immediately the presence of the beetle is suspected or discovered. A full description of the insect is given in the Ministry's Advisory Leaflet, No. 71. Any yellowish beetle with black stripes, or any red or reddish-yellow grub, that is found feeding upon potato leaves should be regarded with suspicion. When such beetles or grubs are discovered, specimens should be placed in a tin box (in which no holes should be punched) with a piece of potato leaf, and the box should be sent to the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1, with a letter stating the exact place where the insects were caught and the name and address of the finder. No other steps should be taken until instructions are received from the Ministry; it is especially important that the crop should not be sprayed or interfered with, as this is likely to cause the beetles to spread, and an outbreak possibly affecting only a few square yards may be distributed throughout a field. Apart from the specimens sent to the Ministry, no beetles or grubs should be removed. The object of these measures is to keep the insect confined to as small an area as possible, so that it may be eradicated without loss of time.

### *Discovery*: an African Number

*Discovery* of June, in an opportune moment, is concerned almost exclusively with Africa. It opens, immediately after editorial notes and comments, with an article by Prof. C. G. Seligman on human types in tropical Africa. Prof. Seligman explains how it has come about that the usual classification of the native peoples of the continent is based on linguistics rather than on physical characters, and then sets out the distribution and characteristics of the major racial divisions in the tropical area. Dr. H. E. Hurst, in a study of the Upper Nile, discusses questions relating to water supply at the source, and indicates where there is necessity for further research. Of the remaining articles, two in particular require mention. Capt. William Hichens's account of demoniac possession is a valuable report by an eye-witness of a recent outbreak of *Kupagawa na pepo* ("ridden by demons"), which amounted almost to an epidemic in Mombasa and other towns of East Africa. He describes the various forms of demon dances by which the spirits were exorcised. In another article, G. A. Gardner, field director of the Archæological Committee of the University of Pretoria, describes the results of further excavations at Mapunggubwe on the south side of the Limpopo River. The partial excavation of a mound, which was found to consist of village refuse, confirms the results of previous excavation on an adjacent area which has been described by Prof. C. van Riet Lowe. He ascribed the earlier of the two occupations then discovered to the Sotho. This is regarded as the earliest trace of Bantu culture known in the Union. The mound excavated by Capt. Gardner was entirely Sotho. It had a depth of 20 ft. and consisted of about 40,000 tons of material. It was found to be centrally situated in a village from which had come the refuse of which it was composed. There was no iron, but copper ornaments, bangles and bracelets were plentiful. The burials were disarticulated with the skull on top of the bones. In several instances cow bones were associated with the human remains.

### World Power Conference

THE death last May of Mr. D. N. Dunlop, chairman of the International Executive Council of the World Power Conference and of the British National

Committee, left a vacancy which was hard to fill. It has been filled, however, by the unanimous election of Sir Harold Hartley, chairman of the British National Committee. By invitation of the American Government, the third World Power Conference will be held in Washington, U.S.A., on September 7–12. The subject matter will be National Power Economy. This will be the third plenary meeting of the World Power Conference, previous plenary meetings having been held at Wembley (1924) and Berlin (1930). There have also been a number of sectional meetings with more limited programmes. The Chemical Engineering Congress meeting in London next week, to which reference is made on p. 1018, is such a sectional meeting. The International Commission on Large Dams of the World Power Conference will be held at Washington concurrently with the third World Power Conference. Work has been continued during 1935 on investigating special cement for use in the construction of dams, and in connexion with the establishment of the international statistical register of large dams.

### Seventh International Congress of Refrigeration

UNDER the auspices of the International Institute of Refrigeration, which has its headquarters in Paris, a congress reflecting all sides of the practice and theory of refrigeration, to which the Governments of more than fifty countries are sending official delegates, is being held at The Hague on June 16–27. The British party visiting Holland, numbering about eighty persons, and headed by Dr. Ezer Griffiths, president of the British Association of Refrigeration, is the largest overseas delegation to the Congress. By the co-operation of Lord Rutherford and Prof. F. A. Lindemann, several well-known scientific workers from Cambridge and Oxford are reading papers on very-low temperature research, in which subject the president of the congress, Dr. W. H. Keesom, of Leyden, is a leading authority. The Food Investigation Board has also sent representatives who are contributing reports on food research. Refrigeration is such an important factor in everyday life nowadays, not only in relation to food supply but also as an auxiliary process in many industries, that the two hundred papers presented to the Congress barely exhaust the many phases of this modern branch of engineering development. The International Institute promoting this series of congresses is established under Government convention.

### War and Populations

IN a discussion of war and over-population (*Current History*, March 1936), Prof. Raymond Pearl states that the aggressor in every major war in recent times has given the need for more room for his people as the primary motive. The land surface of the earth is some 52,000,000 square miles, about one fourth of which is arid or semi-arid, while lakes and mountains still further reduce the cultivable land on which more than 2,000 million people have to dwell. An equal distribution would give each individual about sixteen acres, but probably little more than half would be available for production. The United States census for 1930 showed a population density of 40·6 per square mile—very close to the world average. Europe has 92 per square mile, Asia 76, North America 19–20, South America and Africa about 12, Australia and Oceania only 3. Among countries of the world, China stands seventh and India fifteenth in density of population. The province of Kiangsu alone, having 897 persons per square mile, has a greater population density than Belgium, while Bermuda has 1,462 per square mile. India has 195, about the same as France, but large areas of jungle and desert increase the population density of the rest. Urbanisation, however, leads to greater local densities in the West than the East. Nevertheless, highly industrialised countries can induce few of their people to emigrate to colonies. Up to 1914, Italy had placed only 8,000 Italians in her African colonies, and Germany only 24,000 Germans in her colonial empire. Pearl estimates that the British, Russian, French and American "Empires" control 57 per cent of the earth's land surface; but concludes that the conquest of these lands by other nations would not benefit the human race, while war would impoverish all the nations involved.

### Industrial Prospecting

THE U.S. National Research Council (Washington, D.C.) has reprinted a lecture entitled "Industrial Prospecting" which was delivered before the Founder Societies of Engineers by Mr. C. F. Kettering, chairman of the Division of Engineering and Industrial Research of the National Research Council. Mr. Kettering argues that scientific advancement has not outpaced social and economic advancement, but that, on the contrary, scientific development is 15–20 years behind social and economic development. More research is needed, since research is a way of finding out what is to be done when it is impossible to keep on doing what is being done now. New industries need to be developed in order to provide more jobs. Research is industrial prospecting, and one reason why it has not been more used is that the wrong kind of book-keeping has been followed. In manufacturing, detailed costs must be determined and each individual part must be charged with the appropriate overheads, material, processing, distribution and advertising costs; but research is not manufacturing since there is nothing to sell but ideas. In industrial prospecting each individual project cannot be expected to show a profit at the end of a set time; but taking a large number of projects over a long period of time, if the results show progress it is worth carrying on; if they do not, it ought to be cut out. Industry has been criticised for having too large a capacity, but there cannot be too large a capacity until everyone has the things he needs and wants. What should really be said is that there are too few products for the factories to make. To-day new things are needed, and we have not exhausted even a small percentage of our ability to make improvements or further developments, or to increase the utility of a product.

### Work of the Falmouth Observatory

THE Report of the Falmouth Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council for 1935 is a small booklet which includes meteorological notes and tables for that year. The Observatory possesses records for various meteorological elements that extend back so far as 1871, from which sixty-five year averages have been computed. These are included in the publication, and are used as a basis for comparison of each of the past five years with the sixty-five years in question. It may be noted that 1935 completes one of the lustra recommended as a basis for such comparisons by the International Meteorological Congress of 1887. The rainfall figures show that only one of these five years (1931) was wetter than the average, and by only a small margin, and those for atmospheric pressure show that 1935 was the only one that had not a substantial excess of pressure. Temperature was above the average in each year; the mean for the lustrum was 51·9°, which is identical with the mean for the previous lustrum, this figure being 1·2° above the average. It is interesting to note that temperature at Falmouth has been above the normal for thirteen successive years. The outstanding event of the year 1935 was the snowstorm of May 17. The cold was very much less severe on that day at Falmouth than over most of the country, for temperature there did not fall below 35° in the screen; but on May 14 there was an unusually late ground frost, and this caused very severe damage to crops in some parts of Cornwall. In the section dealing with sunshine, reference is made to the fact that, according to an Air Ministry Pamphlet (No. 69), in two respects Falmouth is the most favoured place in the British Isles in that it has the smallest number of sunless days and the highest number of days with sunshine of more than three, six, and nine hours' duration. Cornwall, in addition to considerable immunity from frost, escapes extremes of heat; at Falmouth the temperature has reached 80° in only eight years out of the last sixty-five.

### Loan Collections for Museums

IT cannot be too widely known that there are available for local museums and art galleries small collections of objects of art and of scientific interest on loan from the British Museum and the Victoria and Albert Museum. The objects are accurately labelled, and each set is contained in "one museum case of the ordinary type". The collections cover a wide field of interest. For example, to mention a few, the Victoria and Albert Museum has forty-three sets illustrating Far Eastern pottery and porcelain, thirty-four sets of English pottery, porcelain and tiles, fifteen sets of English silver and Sheffield plate, twenty-seven sets of English and twenty-nine of European embroideries and woven fabrics, and six sets of musical instruments. On three months' loan from the same museum may be obtained collections of water-colours of the British school, Charles Keene's *Punch* drawings, Japanese colour prints with the tools and materials used in the process. Somewhat similar collections are lent by the British Museum, including water colours by J. M. W. Turner, and additional sets illustrating typical Egyptian gods, and the handiwork of the Bronze and Stone Ages. Information about the conditions on which the loan collections are issued may be obtained from the directors of the museums mentioned.

### Corrosion of Iron and Steel

THE Joint Corrosion Committee of the Iron and Steel Institute and the British Iron and Steel Federation has so far presented three reports which contain a large amount of information. Although the work is at the present time in a very preliminary stage, particularly perhaps with regard to the effect of the protection provided by paint coatings, there is, in view of the extreme importance of the subject, every justification for presenting a short abstract of the results so far obtained. This has been done by Dr. W. H. Hatfield in "The Work of the Corrosion Committee", Special Report, No. 11. This summary, which is extremely well done, contains some provisional conclusions of considerable practical importance, and may be recommended most strongly to all who are concerned with the corrosion, or the protection from corrosion, of ordinary steel structures.

### Canada's Datum Level

THE use of different datum planes in Canadian surveys has in the past led to some confusion. The first precise levels run in 1883 were linked to the United States Coast and Geodetic Survey datum level, but since then others have been used. All precise levelling is now under control of the Geodetic Survey of the Department of the Interior, and an order in council dated March 11, 1935, is quoted in the *Canadian Surveyor* of January. This order decrees that mean sea-level as determined at coastal points by the Canadian Hydrographic Service shall be the official datum line for elevation in Canada, and shall be known as the Canadian Geodetic Datum.

### John Innes Horticultural Institution

AN informative record of the work of the John Innes Horticultural Institution, Merton, London, S.W.19, from 1910 (the time of its foundation) until 1935, has recently been published. The record opens with a brief survey of the history of the Institution, which was founded by John Innes, a merchant of the City of London. At the beginning, the scope of the work there consisted mainly of genetics, but was later extended to include cytology, biochemistry, mycology, X-ray work and further special investigations. The first director was Dr. W. Bateson, who was succeeded by the present director, Sir Daniel Hall. A very useful list of staff and other workers, who have been at the Institution during the past twenty-five years, is included. Their past and present professional appointments are given. This list is followed by lists of present and past members of the garden staff, and these are followed by a valuable bibliography of publications by the staff, past and present.

### Simplified Mandelic Acid Treatment of Urinary Infections

THE use of mandelic acid, a new urinary antiseptic, was the subject of a note in a former issue of NATURE (136, 482; 1935). In order that the antiseptic action may be exerted, it is necessary for the urine to be acid (pH below 5·5), and this was at first effected by the simultaneous administration of ammonium chloride in an amount of 4–8 gm. daily. Treatment with this agent has now been simplified in various ways, which also tend to reduce the disadvantages of the original method, such as the risk of nausea and vomiting, excessive acidity, and albuminuria with casts. Boots Pure Drug Co., Ltd., Station Road, Nottingham, compound the mandelic acid with acid sodium phosphate as the acidifying agent, with sodium bicarbonate in sufficient quantity to neutralise the acid, and suitably sweetened with saccharin. This preparation is put up under the name of 'Neoket', compound mandelic acid granules, the dose of which is two teaspoonfuls in a little water four times a day. The British Drug Houses, Ltd., Graham Street, London, N.1, make use of ammonium mandelate, which is put in the form of an elixir under the name of 'Mandelix', of which 2 fluid drachms constitutes the normal adult dose. This usually suffices to maintain the requisite acidity; exceptionally, it may be necessary to administer ammonium chloride in addition, for which purpose capsules containing gram-doses are supplied. A 'Mandelix Outfit' contains these agents, together with a testing outfit to ensure the proper urinary acidity. Descriptive booklets may be obtained on application from the two firms named.

### Mining in South Australia

WE have received from the Department of Mines, South Australia, the "Mining Review", No. 62, for the half year ending June 30, 1935. After some preliminary notes on recent mining legislation, including where and how to get more details for those who require them, there follows a series of reports on Government drilling and Government gold and silver recovery, reports of the Commonwealth Council of Scientific and Industrial Research, reports by the Government assistant geologist and various inspectors of mines, etc. The total value of the mineral production of the State of South Australia from 1841 until 1934 is given as 53¼ million sterling, of which copper ranks for something more than 33 millions, ironstone for 12,200,000 and gold only for 1¾ millions, the production of the other minerals being unimportant.

### Czechoslovak Microchemical Society

A CZECHOSLOVAK Microchemical Society was founded on April 25 in Prague at a gathering of about two hundred chemists, from both Czech and German scientific and industrial circles. Prof. J. Heyrovský, professor of physical chemistry at the Charles University, known for his microchemical polarographic studies, has been elected president. The Society's activities were inaugurated by a lecture by Dr. C. J. van Nieuwenburg, professor of analytical chemistry in the Delft Technical High School, on "Why and Where Microchemistry?" Austrian microchemists were represented by Prof. Fritz Feigl, professor of chemistry in the University of Vienna. The Society intends to co-operate with microchemical societies and clubs of England, America, Holland and Austria with the view of establishing an International Microchemical Society. The official title of the Society is "Societas microchemica Č.S.R." and its address Prague II, Albertov 2030.

### Eugenics Research

LAST year, a Darwin Research Studentship, tenable for two years, was established by the Eugenics Society in honour of Major Leonard Darwin, the award being made to Dr. R. B. Cattell, director of the School Psychological Clinic of Leicester. Dr. Cattell has been investigating the application of intelligence tests to (a) a typical urban, (b) a typical rural population of school children, to determine the average size of family at each level of intelligence. He is also applying intelligence tests to adults and children in the same families, to determine the correlation rates between parents and offspring. A second Darwin Research Studentship has now been established by the Eugenics Society on the same terms, for the investigation of racial crossing. The holder of this Studentship, which is of the value of £250 a year, will begin work in October. The particular aspects of racial crossing to be investigated will be determined after applications have been received.

### The 200-in. Telescope Disk

THE successful casting of the 200-in. telescope disk at the Corning Glass Works, America, has aroused world-wide interest during the past eighteen months. An opportunity is being given to English scientific workers to learn some of the details of this achievement since Dr. J. C. Hostetter, director of development research at the Corning Glass Works, who has been intimately associated with the casting of the disk, is to give an address on the subject on Friday afternoon, July 3, at 4.30 p.m. in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, London. The lecture has been arranged under the auspices of the International Congress on Glass which opens in London on July 2, and Sir William Bragg has kindly consented to take the chair at the lecture. Admission is free and no tickets are required. Further information, however, may be obtained from Prof. W. E. S. Turner, General Organising Secretary, International Congress on Glass, University, Darnall Road, Sheffield, 9.

### Royal Geographical Society: Medals and Grants

HIS MAJESTY THE KING has approved the following awards of the Royal Medals of the Royal Geographical Society: *Founder's Medal* to Mr. G. W. Murray, director of desert surveys, Egypt, for his long-continued explorations and surveys in the deserts of Sinai and eastern Egypt; for his studies of Badawin tribes, and his unstinted help to desert expeditions; *Patron's Medal* to Major R. E. Cheesman, for valuable

service to geography during nine years residence in north-west Ethiopia, including reconnaissance and surveys of the course of the Blue Nile and exploration of Lake Tana and its islands. The Council of the Society has made the following awards: *Victoria Medal* to Dr. Stanley Kemp, for his work in surveys of the Southern Ocean; *Murchison Grant* to Mr. Michael Leahy, for his explorations of Central New Guinea; *Back Grant* to Muhammad Ayub Khan, for his surveys on three expeditions under the leadership of Sir Aurel Stein in East Persia, 1931–34; *Cuthbert Peek Grant* to Mr. T. H. Harrisson, to assist him in his proposed expedition to New Guinea; *Gill Memorial* to Lieut. A. L. Nelson, for his charts of the South Sandwich Group, South Orkneys, and South Shetlands.

### Announcements

THE Secretary of State for the Home Department, the Minister of Health and the Secretary of State for Scotland have appointed Mr. J. F. E. Prideaux, as assistant director of medical services, Ministry of Pensions, to be a member of the Inter-Departmental Committee appointed in April, 1936, to inquire into the arrangements made in Great Britain for the restoration of the working capacity of persons injured by accidents.

THE fifteenth international medical congress known as *Les Journées Médicales de Bruxelles* will be held at Brussels under the presidency of Prof. Robert Danis on June 20–24. Further information can be obtained from the Secretariat, 141 rue Belliard, Brussels.

THE tenth general meeting of the DECHEMA (Deutsche Gesellschaft für chemisches Apparatewesen E.V.) will take place in Munich on July 10, on the occasion of the general meeting of the Society of German Chemists.

THE Senate of Buenos Ayres has passed a Bill whereby 150,000 Argentine pesos (about £8,400) will be allowed yearly for the upkeep of a national institute of physics in its application to human pathology. Dr. Mariano R. Castex has been appointed director.

AN International Congress of Anatomy, organised by the Italian Society of Anatomy, in which the corresponding societies of Great Britain, Italy, France, Germany, North America, Poland, Holland, Portugal and Latin America will take part will be held at Milan on September 3–8. Further information can be obtained from the general secretary, 31 Via Mangiagalli, Milan.

THE twenty-fifth anniversary of the Sociedad Astronómica de España y América will be celebrated in Barcelona in October 1936 in connexion with an International Astronomical Exhibition which is being sponsored by the Spanish authorities. Particulars of the meeting can be obtained from the president of the society, Dr. J. Comas Solà, Paso de la Enseñanza, 6, Barcelona.

THE following appointments have recently been made by the Secretary of State for the Colonies: D. W. Bishopp to be economic geologist, British Guiana; F. G. Walton-Smith to be biological assistant, Sponge Fishery Investigation, Bahamas; L. V. Waumsley to be engineer, Posts and Telegraphs Department, Malaya; F. W. Winckley to be tobacco specialist, Jamaica; Dr. G. Bryce (senior agricultural officer) to be assistant director of agriculture, Nigeria; C. J. Tyndale-Briscoe (superintendent of education, Tanganyika) to be director of native education, Northern Rhodesia; R. H. Tyrwhitt-Drake (district surveyor, Kenya) to be director of surveys and land settlement, Zanzibar.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of mathematics and a teacher of technical drawing in the Wandsworth Technical Institute, London, S.W.18—The Secretary (June 22).

A lecturer (Grade IIc.) in organic chemistry and an assistant lecturer (Grade III) in chemistry in the University of Birmingham—The Secretary (June 25).

A lecturer in metallurgy in the Chelsea Polytechnic, Manresa Road, London, S.W.3—The Principal (June 25).

A lecturer in metallurgy in the British Foundry School—The Secretary, British Foundry School, Central Technical College, Suffolk Street, Birmingham (June 26).

A male junior assistant chemist in the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (June 27).

A teacher of mechanical engineering in the Smethwick Municipal College—The Director of Education, Education Offices, 215 High Street, Smethwick (June 27).

An assistant lecturer (Grade III) in physics in the University of Liverpool—The Lyon Jones Professor of Physics (June 30).

A principal of the National Training College of Domestic Subjects, 72 Buckingham Palace Road, London, S.W.1—The Chairman of the Governing Body (June 30).

An assistant physicist (X-ray and radium work) at the Hammersmith and Lambeth Hospitals—The Medical Officer of Health (Staff Division 2), County Hall, Westminster Bridge, S.E.1 (July 1).

An organiser of School Museum Service in Derbyshire—The Director of Education, County Education Office, St. Mary's Gate, Derby (July 7).

A professor of botany in University College, Nottingham—The Registrar (July 11).

A University lecturer in geography in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology (July 15).

An assistant to the chief engineer of the Port of London Authority, London, E.C.3—The General Manager (July 17).

A professor of geology in the University of Aberdeen—The Secretary (August 31).

# Letters to the Editor

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Notes on points in some of this week's letters appear on p. 1036.

Correspondents are invited to attach similar summaries to their communications.

## Theory of the Stern-Gerlach Effect

In continuing the development of the theory of the masses of protons and electrons, according to which $m_p$, $m_e$ are the two roots of the equation

$$10\,m^2 - 136\,mm_0 + m_0 = 0,$$

I have obtained a confirmation which seems of interest. Considering a hydrogen atom, and introducing a magnetic field by a gauge transformation, the theory is found to give values of the magnetic energy which agree with the results of the Stern-Gerlach experiment—results commonly (but, as it would seem, wrongly) supposed to show that the proton has 5/2 units of spin. It is difficult to describe this application apart from the rather comprehensive theory—contained in a book now in the press—to which it belongs; but the following will perhaps indicate the line of treatment.

As in celestial mechanics, we analyse the motion of the two particles forming the hydrogen atom into an external motion, represented by a mass $M = m_p + m_e$ moving with the centre of mass, and an internal motion, represented by a mass $\mu = m_p m_e/(m_p + m_e)$ associated with the relative co-ordinates. Correspondingly, we have external wave functions $\psi_e$, $\varphi_e$ similar to those of a free electron or proton, and internal wave functions $\psi_i$, $\varphi_i$ which are the well-known functions determining the internal quantum states of the atom. Each wave function is a superposition of elementary wave functions distinguished by parameters which we denote collectively by $\alpha$; denoting the co-ordinates $(x, y, z, t)$ collectively by $x$, we denote the elementary functions by $\psi(x, \alpha)$. An essential difference between the external and internal wave functions is that $\psi_e(x, \alpha)$ is a continuous function of $\alpha$, but $\psi_i(x, \alpha)$ exists only for discrete values of $\alpha$.

In current practice, the difference between continuous and discrete wave functions is inadequately considered (more especially in formulating the relation between double and simple wave functions); and my determination of the masses $m_p$, $m_e$ was obtained by showing that, *in order to validate the current practice*, it is necessary that the masses should satisfy the equation above-mentioned, or equivalently that $M/\mu$ should be $136^2/10$. More precisely, it is the general dynamical equations which are validated by assigning these masses to the elementary particles. But, if we apply a gauge transformation, continuous and discrete wave functions must still be distinguished; for $\psi_i\varphi_i$ represents a density in a 4-dimensional volume element $dx$, and $\psi_e\varphi_e$ represents a density in a 10-dimensional volume-element $dxd\alpha$. (The number of dimensions of $dxd\alpha$ is found in the investigation of the masses, and supplies the denominator 10 in the above value of $M/\mu$.)

We employ an imaginary gauge transformation to create a fictitious electromagnetic field in the same way that an acceleration of the co-ordinate frame is employed in Einstein's theory to create a fictitious gravitational field. If the 4-dimensional volume-element is multiplied by $e^{-2i\kappa_\mu x_\mu}$, the 10-dimensional element is multiplied by $e^{-5i\kappa_\mu x_\mu}$. The corresponding densities $\psi_i\varphi_i$, $\psi_e\varphi_e$ are changed in the inverse ratio; so that $\psi_i$, $\varphi_i$ become multiplied by $e^{i\kappa_\mu x_\mu}$, and $\psi_e$, $\varphi_e$ become multiplied by $e^{5i\kappa_\mu x_\mu/2}$. (It is necessary to mention that the wave functions $\psi$, $\varphi$ used in the present theory undergo the same gauge transformation, $\varphi$ being defined differently from the corresponding function in Dirac's theory, which would undergo the inverse transformation to $\psi$.) It follows that for the same transformation of gauge, and therefore for the same macroscopic electromagnetic field, the momentum operators are:

For discrete wave functions, $-i\partial/\partial x_\mu + \kappa_\mu$;
For continuous wave functions, $-i\partial/\partial x_\mu + (5/2)\,\kappa_\mu$.

The factor 5/2 is carried through into the mutual energy of the particle and field; so that the particle of mass $M$ with continuous wave functions has a magnetic moment proportionately 5/2 times as great as the particle of mass $\mu$ with discrete wave functions. The common interpretation of the experiment confuses the fictitious particle corresponding to the external wave function with the proton, and that corresponding to the internal function with the electron, $M$ and $\mu$ being very nearly equal to $m_p$ and $m_e$, respectively.

The foregoing result applies to strong magnetic fields. A magnetic field determines a definite time-direction, namely, that with respect to which it is purely magnetic, the electrical components vanishing. When the field is strong, the internal states of the atom are coupled to this time-direction. When the field is weak this coupling ceases, and the 'time' in the internal state is a co-ordinate of a different character. Although usually denoted by $t$, it is a (linearised) interchange co-ordinate. The effect of a gauge transformation on this co-ordinate is rather difficult to investigate; but, so far as I can make out, it is gauge-invariant. This would make the volume-element for internal wave functions effectively 3-dimensional, and thus change the Stern-Gerlach factor from 10/4 to 10/3. There appears to be some experimental evidence which supports this expected modification in weak fields.

A. S. Eddington.

Observatory,
Cambridge.
June 6.

## Hyperfine Structure of the Resonance Lines of Silver

THE structure of the resonance lines of silver has been investigated by the method of absorption in an atomic beam, the high resolving power instrument being a Fabry Perot étalon with plate separations between 2 cm. and 10 cm. Each line was found to possess four components; for the line $5\,S_{1/2} - 5\,{}^2P_{3/2}$, 3281 A., the positions were 0·000, − 0·013, − 0·052 and − 0·077 cm.$^{-1}$, and for $5\,S_{1/2} - 5\,{}^2P_{1/2}$, 3383 A., they were 0·000, − 0·013, − 0·058 and − 0·084 cm.$^{-1}$. In both lines the two components of shorter wave-length were nearly equal in intensity and very much stronger than the two of longer wave-length, which were also of nearly equal intensity; photometer curves of the absorption showed that the intensity ratio of the strong lines to the weak lines was approximately 3 : 1.

As the structure is nearly the same in both resonance lines, it must be due mainly to the common level $5\,S_{1/2}$. Silver consists of two isotopes, 107 and 109, their abundancy ratio being about 1·3 : 1. Each isotope must therefore give rise to one of the strong components and one of the weak components, the intensity ratio being 3 : 1; from this it follows that the nuclear spin of both isotopes is ½.

The difference in abundancy of the two isotopes is small, and the two strong lines (and also the two weak lines) are nearly equal in intensity; however, the photometer curves showed that the component at − 0·013 cm.$^{-1}$ was rather stronger than that at 0·000 cm.$^{-1}$ and that at − 0·052 cm.$^{-1}$ was stronger than that at − 0·077 cm.$^{-1}$. It therefore appears probable that − 0·013 cm.$^{-1}$ and − 0·052 cm.$^{-1}$ are due to $^{107}$Ag and 0·000 cm.$^{-1}$ and − 0·077 cm.$^{-1}$ are due to $^{109}$Ag. On this assumption the nuclear magnetic moments, calculated from Goudsmid's formula[1] for the splitting of an $S_{1/2}$ term, are − 0·10 nuclear magneton for $^{107}$Ag and − 0·19 nuclear magneton for $^{109}$Ag. There is also a small isotope shift, the centre of gravity of the lines of $^{107}$Ag being displaced by about + 0·004 cm.$^{-1}$.

The difficulty of measuring the small difference in intensity of the very close lines 0·000 and 0·013 cm.$^{-1}$ is very great, so that the possibility that 0·000 and − 0·052 cm.$^{-1}$ belong to one isotope and − 0·013 and − 0·077 cm.$^{-1}$ to the other, is not quite excluded; in this case the nuclear spins would still be ½, but the magnetic moments would be − 0·13 and − 0·16 nuclear magneton, and the isotope shift 0·014 cm.$^{-1}$.

A doublet structure observed by Hill[2] is in agreement with the above result, the small separations being unresolved on account of the very much greater Doppler width of the lines given by the hollow cathode tube which he used; in order to resolve the smallest separation, the temperature of the tube would have needed to be about 15° Abs. The intensity ratio which he observed was falsified by incomplete resolution, the Doppler wing of the strong component overlapping the weak component; if this is allowed for, the intensity ratio is in agreement with the value 3 : 1.

D. A. JACKSON.
H. KUHN.

Clarendon Laboratory,
Oxford.
May 8.

[1] S. Goudsmid, *Phys. Rev.*, **43**, 636 (1933).
[2] H. Hill, *Phys. Rev.*, **48**, 233 (1935).

## Anomalies in the Fine Structure of the First Spark Spectrum of Iodine

THREE years ago, the multiplet and hyperfine structures of the $^4S$-system of the first spark spectrum of iodine were analysed by me[1], and I deduced the nuclear spin of iodine to be 5/2. Recently, Lacroute[2] has published an extensive multiplet classification of the $^3D$-system, and established numerous terms. It has now become possible to construct the hyperfine structure scheme of this system. I wish to report here remarkable anomalies in the fine structure of certain terms of the $^3D$-system.

The structure of the line λ5678·1 classified by Lacroute as $({}^3D)6s\,{}^3D_2-({}^3D)6p\,{}^3F_2$ is given in Fig. 1. The fine structure intervals in the term $({}^3D)6s\,{}^3D_2$ are

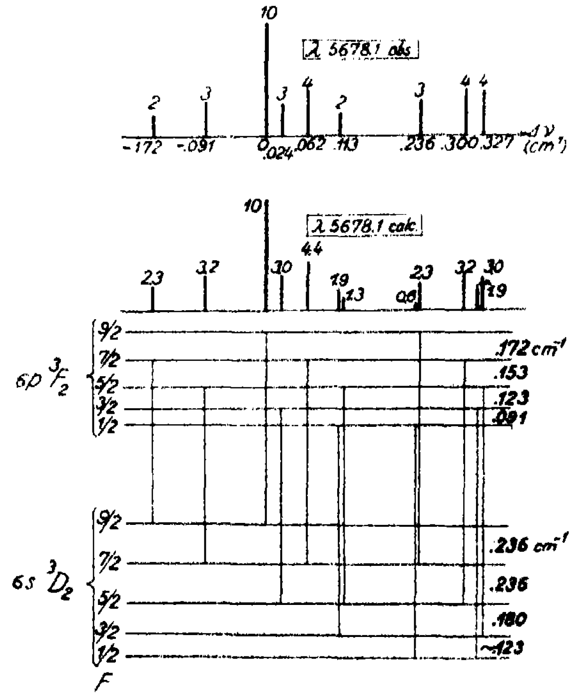


FIG. 1.

irregular and do not obey Landé's interval rule. Next, the line λ4060·2 classified by me as $({}^4S)5d\,{}^5D_0 - ({}^3D)6p\,{}^3D_1$ consists of three components:

0·000 (4), +0·081 (3), +0·121 (2) cm.$^{-1}$.

Numbers in parentheses represent the intensities. Since the $j$-value of the lower term is 0, the intervals of the components give directly the fine structure intervals of the upper term $({}^3D)6p\,{}^3D_1$. Here the $F5/2-7/2$ interval is smaller than the $F3/2-5/2$ interval, a phenomenon which has never been observed in any term of another spectrum.

One might, at first sight, interpret such a break-down of Landé's interval rule as due to perturbation by terms lying very near to $({}^3D)6s\,{}^3D_2$ or $({}^3D)6p\,{}^3D_1$. But I have failed to discover such terms. On the other hand, Casimir[3] has proposed the theory of nuclear electric moment, in order to account for a small systematic deviation from Landé's interval rule. Further extension of his theory will perhaps be able to account, at least qualitatively, for the remarkable anomalies in the iodine spark spectrum.

It may be noted that the data given here are not in agreement with those recently published by

Tolansky[4]. Moreover, the fine structure schemes for the terms $6p^2D_1$ and $6s^2D_2$ reported by him are apparently incorrect, since they can interpret neither his own experimental results nor mine without ambiguity.

Full details will be published in the *Proceedings of the Physico-Mathematical Society of Japan* in the near future.

K. MURAKAWA.

Aeronautical Research Institute,
Imperial University,
Komaba, Tokyo.
April 16.

[1] *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, 29, 285 (1933).
[2] *Ann. Physique*, 3, 5 (1935).
[3] *Physica*, 2, 719 (1935).
[4] *Proc. Phys. Soc.*, 48, 49 (1936).

## Structure of Light Waves

SIR J. J. THOMSON has explained in his recent letter to NATURE[1] that the discontinuity in the structure of light waves (a 'singularity'), to which I directed his attention in my comments[2] upon his views on the nature of light[3], need not be provided, as I wrote, by a permanent "guiding" cylinder of different medium, but can be generated inside the atom and travel with the wave packet.

I do not wish to criticise this hypothesis here, especially as Sir J. J. Thomson apparently does not claim to find yet a complete explanation of the process of ejection of singularities from the atom, but only suggests the way of finding this explanation. However, in view of the fundamental nature of the problem, I think it useful at this stage to formulate briefly the common points and the essential differences in our methods of approaching it.

We both had a common object in view, namely, to connect light and material corpuscles. In pursuing this object, Sir J. J. Thomson in his communication to NATURE, and I in my previous paper[4], both used the same physical idea of axially symmetrical electromagnetic waves propagating *along* the axis, and up to a point followed exactly the same method of mathematical analysis, but the solution of the Maxwell equations which I rejected, mainly in view of the existence of singularities in this solution, proved to be useful to Sir J. J. Thomson just because of it. This was by no means accidental, but very logically followed from the essential difference in the approach to the problem. While Sir J. J. Thomson wanted to introduce singularities (a "core") into the photon, I endeavoured not only to avoid them in the light waves, but also to eliminate them from the "material" corpuscles (and the matter as a separate entity as well)[5].

Which method of approach may prove more fruitful can be judged only from future developments. While I am naturally inclined to regard the method on which I am working as more promising, I fully appreciate the importance of Sir J. J. Thomson's contribution in suggesting the alternative method.

N. S. JAPOLSKY.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
May 21.

[1] NATURE, 137, 823, May 16, 1936.
[2] NATURE, 137, 663, April 18, 1936.
[3] NATURE, 137, 232, February 8, 1936.
[4] Z. Phys., 54, 1 and 2, 121 (1929).
[5] Phil. Mag., 19, 934, ibid., 20, 417 and 641 (1935).

## Viscosity of Air

IN deducing the value of the electronic charge, Millikan assumed for the viscosity of air $\eta_{23} = (1822 \cdot 7 \pm 0 \cdot 9) \times 10^{-7}$. Recently Kellström[1] has obtained the value $\eta_{23} = (1834 \cdot 8 \pm 3 \cdot 0) \times 10^{-7}$, by a rotating cylinder method. This higher value, together with Millikan's data, leads[2] to $e = (4 \cdot 816 \pm 0 \cdot 013) \times 10^{-10}$ E.S.U., in agreement with the X-ray-grating-crystal estimates of $e$.

During the last few months, I have measured the viscosity of dry air (at atmospheric pressure) by a capillary tube method. The ends of a wide-limbed 'U' tube containing paraffin oil (of density 0·87) were connected by a *closed* system consisting of two capillary tubes in series. Initially the oil is displaced, and in attaining equilibrium it drives air through the capillaries. Care was taken to avoid constant and systematic errors; and two 'U' tubes, two sets of calibrated capillary tubes, and two methods of drying the air were used. The experiments were carried out at temperatures ranging from 13·6° C. to 16·9° C. Assuming that $\eta$ increases by $4 \cdot 93 \times 10^{-7}$ per degree centigrade rise in temperature[3], I find

$$\eta_{23} = (1834 \cdot 7 \pm 0 \cdot 8) \times 10^{-7}.$$

I had expected that my result would confirm the lower estimate of the viscosity; but it is in good agreement with Kellström's value.

Using Millikan's and the more recent oil-drop data[4], together with my value for the viscosity, I deduce the two estimates:

$$e = \begin{Bmatrix} 4 \cdot 816 \pm 0 \cdot 005 \\ 4 \cdot 800 \pm 0 \cdot 005 \end{Bmatrix} \times 10^{-10} \text{ E.S.U.}$$

W. N. BOND.

University,
Reading.
May 4.

[1] G. Kellström, NATURE, 136, 682 (1935).
[2] R. T. Birge, *Phys. Rev.*, 48, 918 (1935).
[3] R. A. Millikan, *Ann. Physik*, 41, 759 (1913).
[4] E. Bäcklin and H. Flemberg, NATURE, 137, 655 (1936).

## An Interesting Infra-Red Absorption Band in Fused Quartz

To check the calibration of an infra-red spectrometer, we attempted to locate a fairly sharp band of fused quartz reported by Dreisch[1] as existing at 2·75μ with an intensity of absorption of 75 per cent when a 5 mm. specimen was used, and located by Parlin[2] at 2·71μ with an intensity of absorption of 55 per cent in a 2 mm. specimen. To our surprise, no such band appeared, although we used several different plate and lens specimens, the thickest sample having a thickness of 5 mm. In the meantime, a paper by Drummond[3] has appeared, presenting a careful plotting of the spectra of crystalline and fused quartz. With 6 mm. samples of the latter, he found a 2·73μ band with a 20 per cent absorption. His paper is particularly interesting because it plots for comparison the values of the absorption coefficient $K$ for fused quartz and for the ordinary and extraordinary rays of crystalline quartz. Throughout the 4–8μ region, the graph for fused quartz assumes a kind of average position for the other two, which are qualitatively similar to each other. But in the 3μ region there is a profound difference, a fact discovered by Dreisch[1], who ascribed it to a destruction of the crystal lattice upon fusion, the inference being

that fusion shifts a 3μ crystalline band to the new position.

An examination of the curves of Dreisch or of Drummond justifies this conclusion. But the variation in the depth of the 2·7μ band in the investigations cited, and its absence in all of our specimens, makes this interpretation doubtful. To account for the variation displayed one would have to postulate an ageing effect; yet it is probable that some of the specimens used by Drummond were older than ours.

It is more probable that the 2·7μ band arises from an impurity which occurs in some samples but not in others. Correspondence with representatives of two companies that manufacture fused quartz ware indicates that this is not an impossible interpretation. A clue to the source of the impurity is contained in a paper by Lord Rayleigh[4], who points out the existence of water and carbon dioxide in at least $SiO_2$ in the *form* of pure sand. *If* the band is caused by either or both of these materials, they must exist as in solution in the fused quartz, since not enough molecules could exist as gas in pockets at a reasonable pressure to produce the depths of band observed. Carbon dioxide has a well-known band at 2·7μ, and recent work of Plyler and Williams[5] on the spectrum of solutions of water in acetone, and as yet unpublished work of Ellis and Kinsey on the absorption of a very dilute solution of water in carbon disulphide seem to indicate that the 3μ band of water in dilute solutions assumes a position more nearly equal to that of water vapour near 2·7μ.

J. W. ELLIS.
W. K. LYON.

University of California
at Los Angeles.
April 23.

[1] T. Dreisch, *Z. Phys.*, **42**, 426 (1927).
[2] W. A. Parlin, *Phys. Rev.*, **34**, 81 (1929).
[3] D. G. Drummond, *Proc. Roy. Soc.*, A, **153**, 318 (1936).
[4] Rayleigh, *Proc. Opt. Convention*, 1, 41 (1926).
[5] Plyler and Williams, *Phys. Rev.*, **15**, 197 (1936).

## Radioactive β-Decay and Nuclear Exchange Force as a Consequence of a Unitary Field Theory

THE hypothesis is put forward that positive electron, neutrino, positive proton and neutron are four different quantum states of one elementary particle. Such an assumption would be trivial unless transitions between the different states occur. It is required that Dirac's equation follows from the theory, and that the conservation law of electric charge holds, so only a small number of transitions are allowed. If in addition we satisfy a certain symmetry condition (corresponding to the conservation law of Jordan's neutrino charge[1]) the number of possible processes is further reduced. The permitted transitions are:

(I) positive electron ⇄ neutrino
(II) positive electron ⇄ neutron
(III) positive proton ⇄ neutrino
(IV) positive proton ⇄ neutron.

Any one of these transmutations can occur only if another one of them takes place in the reverse direction.

Process (IV) (from right to left) and (I) (from left to right) give rise to a transmutation of a neutron into a proton, while simultaneously a positive electron (being in one of the negative energy states of Dirac's theory) becomes a neutrino. Thus a 'Dirac hole' (to be identified with a negative electron) and a neutrino are produced. An explicit calculation according to this theory gives the Fermi[2] formula for radioactive β-decay.

If the transformation (IV) of one particle is coupled with the same transformation (of a second particle) in the reverse direction, the corresponding interaction energy is the one postulated by Majorana[3] in order to explain nuclear constitution (exchange force neutron–proton).

Combining I, II, III and IV, there is a number of further reactions possible which will be discussed elsewhere together with the complete theory[4]. As soon as the neutrino theory of light[5] can be formulated in a satisfactory way, we have a unitary field theory, its field variable being a spinor of 16 components.

ERNEST C. G. STUECKELBERG.

Institut de Physique,
Université de Genève.
May 7.

[1] Jordan, *Z. Phys.*, **99**, 759 (1936).
[2] E. Fermi, *Z. Phys.*, **88**, 161 (1934); Konopinsky and Uhlenbeck, *Phys. Rev.*, **48**, 7 and 107 (1936).
[3] Majorana, *Z. Phys.*, **82**, 137 (1933).
[4] To be published in the *Helv. Phys. Acta*. *Note added in proof:* It seems worth while to point out that combinations between (I) and (III) or between (II) and (IV) which lead to destruction of heavy particles, cannot occur if the negative electron and the positive proton are both considered as *true particles* (being the opposite of the 'holes' or antiparticles in Dirac's theory).
[5] L. de Broglie, "Une nouvelle conception de la lumière", Actualité scient., Hermann, Paris (1934). Further progress has been accomplished by Wentzel, Jordan, Kronig and Scherzer; for references compare Jordan (ref. 1) and *Z. Phys.*, **99**, 112 (1936). See also Kronig, NATURE, **137**, 149 (1936).

## Influence of Œstrogens on the Prostate Gland

RECENT investigation[1] suggests that the benign enlargement of the prostate which occurs spontaneously both in elderly men and aged dogs is a consequence of œstrogenic stimulation. No evidence has, however, been found hitherto which demonstrates the identity of the histological changes throughout the naturally and experimentally enlarged prostates, and only such evidence can provide the conclusive step in the substantiation of the hypothesis. It is therefore important to record the fact that a specimen of a spontaneously enlarged prostate in a dog, which has recently become available for study, presents a histological picture identical with that provided by the prostates of dogs experimentally treated with relatively large doses of œstrone[2]. The characteristic epithelial changes of the experimental prostate, which are not seen in the usual spontaneous enlargement, are reproduced in detail in this specimen, and it may be assumed that their usual absence is due to a lesser degree of œstrogenic stimulation than was the case in the animal under consideration.

The specimen will shortly be reported on in detail in collaboration with Mr. J. R. Groome, of the Department of Zoology, University of Oxford.

S. ZUCKERMAN.

Department of Human Anatomy,
Oxford.
May 27.

[1] S. E. de Jongh, *Arch. Int. Pharm. Therap.*, **50**, 348 (1935). H Burrows, *Amer. J. Cancer*, **23**, 490 (1935). A. S. Parkes and S. Zuckerman, *Lancet*, **229**, 925 (1935). S. Zuckerman, ibid., **230**, 135 (1936).
[2] S. E. de Jongh, *Acta Brev. Neer.*, **5**, No. 10 (1935).

## Raman Effect of Gaseous and Liquid Sulphur Trioxide and of Mixtures of the Trioxide with the Dioxide

THE number of Raman frequencies to be expected for the molecule $SO_3$ is either three or four, according as it has the symmetry $D_{3h}$ (plane form) or $C_{3v}$ (pyramidal symmetry). The Raman spectrum of gaseous sulphur trioxide was determined with a Hilger $E_1$ spectrograph, but only the frequency $1068 \cdot 5 \pm 0 \cdot 5$ was found with certainty[1]. A decision on the structure is thus not possible, as the infra-red absorption of sulphur trioxide is, so far as we know, unknown.

Bhagavantam examined the Raman spectrum of the *liquid* trioxide and its change with temperature. The intensities of the frequencies 535, 1068 and 1403 as given by him increased with temperature, whereas the *intensities* of the other lines (290, 370, 666, 697, 1271 and 1489) diminished. His main results were confirmed by us; the changes in intensities with temperature, though very distinct, were found somewhat less pronounced. In long exposures the very weak lines 650 and 1516, mentioned by Venkateswaran[3], were also found.

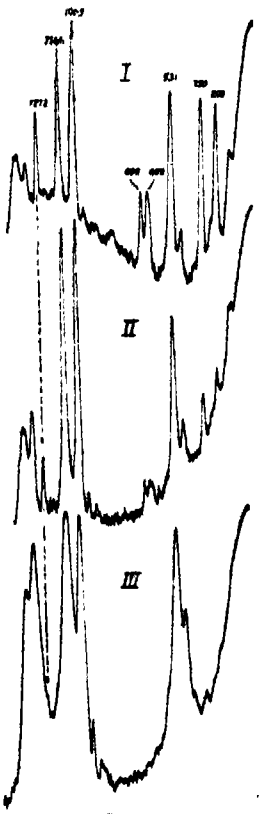


FIG. 1.

The number of frequencies found for the liquid is far too large to be explained by the presence of only single molecules, $SO_3$, even if one takes into account the possibility of resonance degeneracy causing the splitting up of one line into two others; this has led Bhagavantam[2] to the hypothesis of the complexity of the liquid, a view put forward long ago for this substance by A. Smits on account of anomalies in the vapour pressure[4]. The group of lines the intensity of which increases with temperature is ascribed to $(SO_3)_1$; the other lines are thought to belong to a double molecule $S_2O_6$.

If in the liquid an inner equilibrium between $SO_3$ and polymerised molecules $(SO_3)_x$ exists, it would be interesting to study the influence on the Raman effect of the liquid trioxide, when diluting it with another liquid with which it is miscible in all proportions. For that reason the Raman spectrum (at 60°) was determined of mixtures of the trioxide with sulphur dioxide, containing respectively 75, 50 and 25 molecular per cent of trioxide. In all mixtures the three Raman lines of the dioxide were found in intensities determined by the concentration of sulphur dioxide in the mixture. The influence on the Raman lines of the trioxide of diluting it with the dioxide is, on the contrary, very marked, as may be seen from photometer records for the three mixtures reproduced here (Fig. 1) (I, 25 per cent; II, 50 per cent; III, 75 per cent sulphur dioxide respectively). The intensities of the Raman lines 290, 370, 650, 668, 699, 1271, 1490 and 1516 diminish strongly with dilution compared with the lines of the dioxide, whereas the intensities of the lines 530, 1068 and 1390 increase considerably, when one takes account of the relative decrease in concentration of the trioxide, when going from mixture I to mixture III.

The influence of dilution on the Raman spectrum of liquid sulphur trioxide is thus very striking, and in complete agreement with the conception of an inner equilibrium in the liquid between single and polymerised molecules, in the sense of Smits's theory. The dipole moment of the gaseous substance is being measured, as it may facilitate a decision about the symmetry of the molecule. In the case of a plane molecule, the electric moment would be zero.

We are greatly indebted to Prof. Smits for his interest in the work.

H. GERDING.
W. J. NIJVELD.
G. J. MULLER.

Laboratory of Inorganic and Physical Chemistry,
University, Amsterdam.
May 11.

[1] The vapour contains only single molecules; compare A. Smits and N. F. Moerman, NATURE, 134, 698 (1934).
[2] *Phil. Mag.*, (7), 15, 263 (1933).
[3] *Ind. J. Phys.*, 5, part 1, 49 (1930).
[4] A. Smits, *Versl. Kon. Akad. Amsterdam*, 32, 849 (1923); NATURE, 113, 855 (1924).

## Raman Spectrum of the Ice-like form of Sulphur Trioxide

THE Raman spectrum of the ice-like form of solid sulphur trioxide (melting point 16·8°) was measured with the Hilger $E_1$ spectrograph and with a spectrograph of large aperture ($F/2$), but small dispersion, constructed by Kipp. The following lines were found: 292(1), 371(1*d*), 525(0), 662(½), 698(½), 1074(½, not sharp), 1273(2).

A comparison with the results obtained with the trioxide and with mixtures of it with the dioxide (see preceding letter) reveals the fact that the Raman lines of both the molecules $(SO_3)_1$ and $(SO_3)_x$ are present, those of $(SO_3)_x$ having here by far the greater intensities. This is in contrast to the liquid, as may be seen for the strongest frequencies 1068 ( $(SO_3)_1$ ) and 1272 ( $(SO_3)_x$ ) from two photometer records reproduced here (Fig. 2: I, liquid at 70°; II, solid at 12°). It is therefore necessary to assume that the lattice of the *solid* ice-like modification of sulphur trioxide consists of molecules $(SO_3)_x$ (for the larger part) and single molecules $(SO_3)_1$ (in small quantities); in agreement with the hypothesis of the complexity of

the solid sulphur trioxide put forward by A. Smits and his co-workers for explaining the vapour pressure anomalies of this remarkable substance[1].

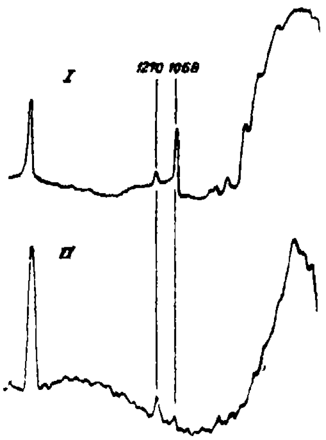


FIG. 2.

We wish to thank Prof. Smits heartily for the interest he took in the work.

H. GERDING.
N. F. MOERMAN.

Laboratory of Inorganic
and Physical Chemistry,
University, Amsterdam.
May 11.

[1] A. Smits, NATURE, 113, 856 (1924); A. Smits and N. F. Moerman, NATURE, 134, 698 (1934).

## Deposits of Colloidal Graphite

IN describing the design of an $\alpha$-particle counter that comprises a leaflet of aluminium attracted to an insulated point conductor, Wassiliew[1] mentions the use of indian ink for fastening a cylindrical conductor to an insulator. Of the conducting contact materials that might be used for this and similar purposes, it is interesting to note that experimenters in the United States have found aqueous colloidal graphite generally useful.

In this instance, a globule of concentrated colloidal graphite in water provides a firm contact accompanied by a decrease in the usual film resistance at the point of application. Such a cement spot not only provides a relatively large area with which to make contact, but also forms a comparatively strong binder for the so-called 'cat's-whisker' type of connexion frequently made for vacuum-condensed substances. It is said[2] that vacua of the order of $10^{-8}$ mm. mercury can be obtained when several graphite contacts are utilised in one device.

Similar contacts[3] to sample insulating materials for the purpose of determining their volume and surface resistivities, dielectric losses and constants, in no way alter the physical properties of the substances in question or interfere with the treatment of specimens between tests. Commercially, colloidal graphite is used to cement carbon filament ends to lead wires in the base of carbon lamps.

Wassiliew also suggests[1] that leaflets of glass sputtered metallically may be employed rather than foils of aluminium or platinum as cathodes of the counter system. For those wishing to eliminate metallic sputtering in the preparation of such conductive leaves, the same result could be obtained by painting with a camel-hair brush a deposit of graphite on sheets of material like Cellophane, glass leaflets or even paper bases.

On an ebonite surface the resistance of a graphite coating formed from a fairly dilute solution is about 3,000 ohms per cm. square, the same being decreased to 2,000 ohms for a polished surface.

Other applications where colloidal graphite deposits may serve in place of metallic sputtering include the coating of Rochelle crystals in piezoelectric problems, the formation of guard rings for evacuated apparatus, coating of plate glass for electrostatic condensers, and the construction of electrodes in ionisation chambers. Commercially, colloidal graphite films are said to be desirable on the cuprous oxide layers of copper oxide rectifiers and on the oxide layers of aluminium foils used in electrolytic condensers.

BERNARD H. PORTER.

444 Madison Avenue,
New York City, N.Y.
April 23.

[1] S. S. Wassiliew, NATURE, 137, 533 (1936).
[2] C. L. Henshaw, Yale University, 1935.
[3] Church and Daynes, *Rubber Ind. Trans.*, 6, No. 1 (1930).

## Origin of the Teleost Scale-Pattern and the Development of the Teleost Scale

ACCORDING to current accounts of scale formation in Teleosts, the scale papillæ originate as independent centres of growth, their constituent cells being derived from the immediately underlying dermis. The remarkable regularity of arrangement of the scales in most fishes has always attracted attention and has led Backman[1] to suggest that each papilla exercises an inhibiting influence on the development of the immediately surrounding tissue.

Recent investigations by me (principally on species of the genus *Salmo*) show that these views are quite incorrect. In *Salmo* the first papillæ arise as aggregations of mesoderm cells along the lateral line, each one immediately beneath a sense organ (neuromast). Each of these primary papillæ soon shows a dorsal and a ventral extension consisting of outgrowing fibroblasts. These outgrowths are inclined obliquely forward, crossing the underlying myotomes and pushing their way between the dermis and epidermis. The other papillæ of the body arise at intervals along these oblique outgrowths and are formed by local multiplication of the fibroblasts. This accounts for the regular sequence of diagonal scale rows which is so characteristic of Teleosts. As regards the spacing of the papillæ along each outgrowth, it may be pointed out that it is a general characteristic of fibroblasts to multiply when packed tightly together. It seems possible that after advancing for a distance the rate of movement of some of the cells is checked, thus producing a 'piling up' of the cells following and resulting in the concentration necessary to induce mitotic activity. This would automatically permit a further advance and a similar check.

It seems likely, therefore, that the general process of scale formation is induced by the lateralis branch of the vagus nerve. In *S. trutta* an apparent exception to the scheme outlined above is to be found in a small mid-dorsal patch of papillæ which arise as an independent centre of fibroblastic activity a little behind the supratemporal canal.

Most recent investigators have concluded either that the fibrillary plate of the scale is laid down first or that the plate and the 'hyalodentine' layer are

formed simultaneously. Actually the 'hyalodentine' layer is formed first. It is laid down after the manner of membrane bone, surrounded by osteoblasts. The term 'hyalodentine' should accordingly be dropped. The fibrillary plate is laid down against the bony layer, being formed probably from substances which have penetrated between the older osteoblasts.

FERRIS NEAVE.

Dept. of Zoology,
University of Manitoba,
Winnipeg, Man.
April 25.

[1] *Verh. anat. Ges. Jena*, 41.

## Negrito Racial Strain in India

THE remnants of the Negrito race in the aboriginal population of South India were first discovered by Dr. B. S. Guha and reported in NATURE[1]. In an extensive survey of the Perambiculam Hills within the Cochin State and the adjoining Anaimallais Hills of the Coimbatore district he found, in all, 16 individuals with spirally curved hair of whom one was a Pulayan, one a Mâlser and the rest were Kadars. The hair of

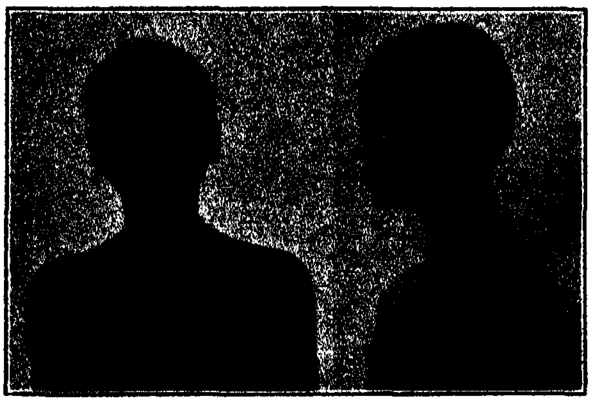

FIG. 1.

these people was of a frizzly type equivalent to No. *g* of Martin's scheme[2], with the exception of two individuals whose hair was of the woolly type and more like No. *h* of the same scheme. In a recent survey of the Hill People of the Rajmahal Hills of Santal Parganas, I came across a boy of about fourteen years of age in a place called Lilkotidhãorã (Rajmahal subdivision) belonging to the *Bãgdi* group with short spirals of a distinctly woolly type (No. *h*) (Fig. 1). He was very short (1,354 mm.). The head was round and short, the maximum length and breadth being 166 mm. and 142 mm. respectively, and the proportions between the two was 85·54. The nose was flat and broad and the face was round and short. The lips, however, were moderate and no prognathism was noticed. The skin colour was black, corresponding to No. 33 of von Luschan scale.

The Negritos found by Dr. Guha were equally pigmented, but appeared to possess a more elongated head, only two showing a cephalic index of 77·34 and 79·29 respectively. Discussing the origin of these people, Dr. Guha has suggested[3] that the basis of the Indian Negritos was probably brachycephalic, but large admixture with a primitive dolichocephalic Nisadic element had afterwards modified the head shape. The Rajmahal boy with woolly hair discovered by me would appear to lend support to this contention, and to indicate, as suggested by Dr. Guha, that the Negritos in India, like the Andamanese, were originally round-headed; and the change of the head shape has been due, as noticed to a smaller extent among the Semangs, to the large absorption of the blood of a primitive dolichocephalic race which is the dominant element among the aboriginal population of Southern and Central India at the present time.

S. S. SARKAR.

Bose Research Institute,
93 Upper Circular Road,
Calcutta.

[1] NATURE, 121, 793 (May 19, 1928); and 123, 942 (June 22, 1929).
[2] "Lehrbuch", Second Ed., 1, 213.
[3] "Census of India", 1, Pt. iii, p. ii, 1935.

## Occurrence and Distribution of Chromosome Aberrations in Nature (Diptera)

THE problem of the frequency, types and distribution of chromosome aberrations in Nature has so far not been studied. Yet in analyses of spontaneous mutations, of the divergency of species and of the structure of population, this problem is of the greatest importance. Several separate cases on the occurrence and distribution of different aberrations in Nature have been described (Sturtevant, Blakeslee, Brink and others).

In the summer of 1935, 1,666 chromosome complexes from the salivary gland cells of the larvæ of *D. melanogaster* from five populations (Kutais, Gori, Batoum, Souchoum, Gelendzhik) were studied. Five different inversions were detected in the large autosomes. Rather high concentrations of inversions were observed in the populations (the percentages of heterozygotes were 5·24; 1·02; 8·28; 0·0; 14·8), owing to which individuals homozygous for inversions were found.

The most frequent chromosome aberration in *D. melanogaster* which contained an inversion in each of the limbs of the second chromosome (CIIL–CIIR) proved to be an allelomorph of the inversion CIILCy–CIIR which was found by Ward in Michigan (1918). Genetic experiments have shown that the individuals possessing two of these inversions are viable and an analysis of the salivary gland chromosomes has shown that they are identical.

The chromosomes of *D. funebris* were studied in 1935–36 in populations taken during December and January in two localities of Moscow. 220 individuals were investigated. About 75 per cent of them contained inversions. Due to this high concentration, some of the individuals were homozygous for inversions and others were heterozygous for two or three of them.

A preliminary study of populations of *D. obscura* and other species of *Drosophila* has also shown the existence of inversions.

An investigation of 250 larvæ from three wild populations of Chironomidæ has shown 20, 43 and 65 per cent of individuals heterozygous for inversions.

All 434 chromosomes bearing inversions have been found. In the species studied about 30 per cent of individuals were heterozygous for inversion.

The outstanding fact that all other types of chromosome aberrations except inversions are missing, proves that their concentration in the populations of the species is very low. This may be caused either by

the peculiarities of the process causing spontaneous mutation or by the differential action of selection for inversions on one hand, and against other aberration types on the other.

The widespread part played by inversions in the divergence of species is apparently reflected in phylogeny (as described in this work), the laws governing the distribution of inversions in populations and the fact that wild populations are saturated with chromosome aberrations.

N. P. DUBININ.
N. N. SOKOLOV.
G. G. TINIAKOV.
Institute of Experimental Biology,
Moscow.

## Origin of the Word 'Monolayer'

PROF. DONNAN asks in NATURE of May 30, p. 910, who originated the word 'monolayer'. I may say that I think I coined it, for my own use, in July 1924 (*Journal of Experimental Medicine*, **40**, 133; 1924).

I had not seen it used before, and therefore explained, in the introduction to my paper, why I thought it advisable and convenient to shorten the cumbrous expression "monomolecular layer". But I should be glad to learn if someone else, unknown to me, was struck by the same idea.

P. LECOMTE DU NOÜY.
Institut Pasteur,
Paris.

## Points from Foregoing Letters

SIR ARTHUR EDDINGTON gives an outline of his theory on the interrelation between the mass of the proton and that of the electron. He states that the theory leads to values for the magnetic energy of the proton in agreement with those found experimentally by the Stern-Gerlach method (deviation of streams of protons in a non-homogeneous magnetic field).

From the fine structure observed by Dr. K. Murakawa in the lines $\lambda 5678 \cdot 1$ and $\lambda 4060 \cdot 2$ of the first spark spectrum of iodine, the fine structure intervals of the terms $(^2D)6s^3D_2$ and $(^2D)6p^3D_1$ have been deduced, and are found to deviate considerably from Landé's interval rule, which states that the successive separations of the components of a multiple term are nominally proportional to the larger value of the inner quantum numbers ($I$) involved.

The essential difference in connexion with the recently expressed views on the nature of light consists, according to Dr. N. S. Japolsky, in that Sir J. J. Thomson introduces singularities (a 'core') into the photon, while he (Dr. Japolsky) not only avoids singularities in the light waves, but also tries to eliminate them from the 'material' corpuscles.

From the intensity ratio of components of the resonance lines of silver, Dr. D. A. Jackson and H. Kuhn deduce a nuclear spin of value $\frac{1}{2}$ for the silver isotopes of mass 107 and 109. The authors also calculate a probable value for the magnetic moments.

Dr. W. N. Bond confirms Kellström's value of $1834 \cdot 7 \times 10^{-7}$ at 23° C. for the viscosity of air. In conjunction with Bäcklin and Flemberg's oil-drop data, this leads to a value of $4 \cdot 800 \times 10^{-10}$ for the electronic charge, in agreement with that obtained from X-ray-grating-crystal experiments.

The absorption of infra-red radiation of wavelength $2 \cdot 7\,\mu$ by certain specimens of fused quartz may be due, according to Prof. J. W. Ellis and W. K. Lyon, to the presence of traces of water or of carbon dioxide, which substances have absorption bands in or near that region.

The hypothesis that any of the four transitions: positive electron or positive proton $\rightleftarrows$ neutron or neutrino can occur provided any given transition is accompanied by a change in the reverse direction, is put forward by Prof. E. C. G. Stueckelberg. He considers the four entities as different quantum states of one particle.

A spontaneously enlarged prostate in a dog is found by Dr. S. Zuckerman to have a structure identical with that of the same organ enlarged experimentally by treatment with the sex-hormone, œstrone. This supports the view that enlargement of the prostate, which may occur spontaneously in elderly men and aged dogs, may be due to œstrogenic stimulation.

On dilution of liquid sulphur trioxide with liquid sulphur dioxide, the relative intensity of certain lines in the Raman spectrum (wave numbers 530, 1068 and 1390, ascribed to single molecules, $(SO_3)_1$) increases, while the intensity of other lines assumed to be due to double molecules, $(SO_3)_2$, decreases. This is taken by Prof. H. Gerding, W. J. Nijveld and G. Muller to confirm the view that liquid sulphur dioxide consists of several kinds of molecules. In the case of the solid, ice-like form of sulphur trioxide, the Raman spectrum indicates the presence of a great proportion of complex molecules $(SO_3)_x$ with a smaller number of $(SO_3)_1$.

Prof. B. H. Porter points out that homogeneous films formed with the aid of aqueous dispersions of colloidal graphite may be used in the construction of $\alpha$-particle counters, guard rings, ionisation chambers, electrolytic condensers, etc., such films being conducting and easily applied.

S. S. Sarkar describes the physical characters of a boy of low stature with spirally curved hair belonging to the Bāgdi group, from the Rajmahal Hills of India. The head measurements support the view that the basis of the Indian negritos was originally broad-headed, and that there has been a change in head shape due to a large admixture with a primitive long-headed race, which is the dominant element among the aboriginal population in southern and central India.

A study of the chromosomes of various strains of fruit flies shows, according to Prof. N. P. Dubinin, N. N. Sokolov and G. G. Tiniakov, that the only common naturally occurring aberration is that due to inversion (in the order of the character-bearing genes). In *Drosophila melanogaster* the inversion occurs most frequently in each of the limbs of the second chromosome.

# Research Items

### New Guinea Pygmies

AMONG the more interesting results of Lord Moyne's expedition to New Guinea, from which the collections are now on exhibition at 10 Grosvenor Place, London, S.W.1 (see NATURE, May 30, p. 898) is the confirmation of rumours as to the existence of a hitherto unrecorded group of pygmies inhabiting the Aiome foothills of the Middle Ramu region between Atemble (about seventy miles from the mouth of the Ramu) and Mount Hagen. Some further particulars of the information relating to this group obtained by Lord Moyne are given by Mr. H. J. Braunholtz in *Man* of June. The members of the expedition were not allowed to enter the villages of the pygmies, as they are 'uncontrolled'; but about twenty-five of the pygmies visited the expedition for trade. Twelve males who were measured averaged 54½ in. (1·385 m.) in stature and three females 51¼ in. (1·31 m.). The extremes ranged from 52 in. to 57 in. and 50½ in. and 53 in. respectively. They were light brown in colour, of about the same shade as light-skinned Polynesians. Mr. Braunholtz points out that these are the lowest figures yet recorded for any pygmy group in New Guinea, and are about equal to those of the pygmies of the Congo. The Tapiro of the Mimika average 57 in., while the next group averages 58½ in., a fact which led H. J. T. Bijlmer in his report on the physical anthropology of New Guinea to question whether there is a pygmy race there at all, regarding these low-statured peoples as local variants of the variable Papuan stock. The Aiome group is, therefore, a new fact of outstanding importance. Several complete pygmy equipments were obtained, a typical outfit including: a bow, three arrows with wide bamboo blades for pig, one four-pronged arrow for birds, four barbed arrows for fighting, two plain pointed arrows; a small round shield slung on the left side in net bag, bone dagger, bamboo louse scratcher with wallaby fur puff, belt of plaited vine, neck pendants of various teeth and seeds, head-dress of bark-cloth, garters and arm bands, pubic covering of bark, pandanus mat for rain.

### Wappo Ethnography

THE Wappo Indians, of whom the modern representatives live on the reservation near Geyserville, California, according to investigations by Mr. Harold E. Driver, who visited them in July 1932 (*Univ. California Pub. American Archæol. and Ethnol.*, **36**, No. 3), are possibly very nearly the most primitive people of whom there is record. The land on which they live, now occupied chiefly by Pomo families, was originally Wappo. Their country was a small territory fifty miles long and fifteen to twenty miles wide north of San Francisco Bay. They inhabited the fertile valleys of a hilly country. They were without writing, metals, agriculture, pottery or domestic animals, even dogs. Their chief food was the acorn, eaten in the form of mush. Small game furnished more of their diet than big game, though deer meat was an important food. They did not hesitate to eat rats, mice, grasshoppers, snails and the like. Homes were mostly of grass-thatch and could be constructed in a day or two. Dress was the minimum, the men being nude and the women wearing a double apron. In cold weather a skin, or woven tule cloak, was worn. The only art of any note was basketry, in which they excelled. In variety of size, shape, weave and quality of workmanship, it rivalled the famous Pomo baskets. In social organisation, they were without clans, real chiefs or definite tribal unity. The social unit was the bilateral kin, with the whole town or village community as the larger unit, numbering at most two or three hundred, but usually about one hundred persons. There was no central authority binding these units together. There was a lack of any far-reaching division of labour; arrow-head makers and clamshell bead makers being the only tradesmen giving their time to special tasks. Their only records were bundles of sticks, mnemonic devices to mark the moons and a few dates in the future. At the birth of a child the custom of couvade was observed by the father, strictly for four days and afterwards with lessening intensity.

### South Wales Oysters

THE report on investigations into the condition of certain of the oyster beds in the South Wales sea fisheries district (June 1934) (*Fish. Invest.*, Series 11, **14**, No. 5; 1935) by F. S. Wright shows good results following experimental work during recent years in order to increase the local oyster population. Especially in the Roads Haul near Mumbles Head, where adult oysters were laid down close together in a reservation in order to breed, were good spat-falls obtained, and it is suggested that work on the same lines be continued in this area. Free-swimming larvæ derived from oysters in the Roads Haul stand an unusually good chance of being transported by currents to adjacent banks which are favourable for their development. In Milford Haven, some Portuguese oysters were laid down, but it is suggested that this be discontinued in view of the fact that indigenous oysters are now available in the district, and restocking should be carried on with this species. The importance of restoring the natural oyster beds is becoming more and more recognised, and the present report is distinctly encouraging.

### A New Tomato Eelworm

A SHORT account by Mr. P. H. Williams (*Gardeners' Chron.*, May 16, 1936) announces the appearance of a new gall-forming disease of the tomato. The galls appear on the stem of an affected plant, are spongy in texture, and are caused by *Anguillulina dipsaci*, an eelworm which attacks a wide variety of plants. The disease has been reproduced upon healthy tomatoes by spraying with a suspension of eggs and living eelworms. Fortunately, the malady is quite rare.

### Dimorphous Basidiospores

MR. E. J. H. CORNER has studied two species of fungi, *Hygrophorus firmus* and *H. hypohæmactus*, and finds that they produce two kinds of basidiospores. Large spores with dense contents are borne upon large basidia, whilst small vacuolated spores occur

on small basidia ("*Hygrophorus* with Dimorphous Basidiospores"; *Trans. Brit. Mycol. Soc.*, 20, Pt. 2, 157–184, January 1936). The paper also contains a full account of a detailed microscopic study relating to the development of the fruit body. *H. hypohæmactus* is described for the first time, and Mr. Corner shows, by the description of sixteen varieties, juvenile forms and overgrowths, that *H. firmus* is an extremely variable species.

### Camomile Lawns

THE modern concept of a lawn can scarcely be associated with any other kind of plant than grass, but in the days before the invention of the lawn mower, broad-leaved herbaceous plants were of frequent occurrence in any well-established sward. Mr. R. B. Dawson, director of the Golf Green Research Station at St. Ives, Bingley, Yorks, discusses the potentialities of camomile (*Anthemis nobilis*) as a lawn plant (*J. Board of Greenkeeping Res.*, 4, No. 14). He has examined a number of lawns in the Royal gardens where camomile is established, and finds that this species is an aggressive coloniser, and very tolerant of drought. Its densely-woven runners supported a mat of deep green foliage when the surrounding grass was parched and dry; it was free from weeds, and gave a fragrant turf. In spite of these advantages, however, it seems unlikely that the plant will be suitable for the closely-mown lawns demanded by modern conditions, and there is a possibility that the resistance to drought would diminish if too many leaves were removed by keen cutting.

### Plant Cover as Protection against Soil Erosion

THIS topic is dealt with very fully by Mr. J. Kramer and Prof. J. E. Weaver of the University of Nebraska, in Bulletin 12 of the Conservation Department of the University, recently published. The controlling of wastage of land through soil erosion is one of the major economic problems in America, and was brought forcibly into the public interest by the great dust storms of 1935. The authors have standardised a technique in which undisturbed samples of field soil of reasonable size can be lifted, with the crops they bear uninjured, and then exposed to erosion by a stream of water directed on to the surface from a hydrant. Numerous data obtained by these methods are assembled and discussed, but the striking general result is the very great protection against rain erosion provided by the above-ground portions of the plant compared with the root system alone. The authors conclude that the character of the crop is a principal factor in erosion control, the effect with plant cover intact exceeding that of underground parts alone from 3 to 7 times. Maximum protection was afforded by winter wheat and sorgo; oats and alfalfa were less effective. Among pasture plants, well-established Hungarian brome grass was found most effective. The authors naturally conclude that the weakening of grasses by over-grazing, trampling and injudicious burning may contribute materially to soil erosion.

### Surveys in Central Asia

A SUMMARY of the state of surveys in Chinese Central Asia including Tibet and Sinkiang is shown on a map produced by the Survey of India and republished in the current volume of the *Himalayan Journal* (8, 1936). The whole of the Himalayas except in parts of Bhutan and Assam are covered at least by exploratory surveys, though some of the work at altitudes above 15,000 feet is still rough. About one quarter of Tibet is now covered by exploratory surveys, and several other parts have a network of explorers' routes; but large areas still remain of which little is known. In those parts early travellers and 'pundit' explorers are the only authorities. In Sinkiang, exploratory surveys seem to cover nearly half the area, and they are almost entirely due to Sir Aurel Stein and his Indian assistants.

### Analysis of a Tropical Hurricane

THE *Monthly Weather Review* of November 1935 contains two papers dealing with the remarkable tropical hurricane that visited the Atlantic coast of the United States early in that month. The first paper, by Willis E. Hurd, gives a detailed account of the life-history of the storm, which apparently began as a feeble disturbance outside the tropics—a very unusual event—a little east of Bermuda in lat. 32° N., on October 30. It moved west by north, passing just north of Bermuda, but turned unexpectedly south-westwards during the night of November 1–2, then almost south on November 2, crossed the northern fringe of the Bahamas on November 3 and the lower part of the Florida peninsula on November 4. In the Gulf of Mexico it described part of a loop that brought it back to the neighbourhood of Florida, where it dissipated on November 8. In addition to the extraordinary nature of the track, it is the first storm on record to develop hurricane winds in the Florida peninsula so late in the season. The hurricane winds covered only a narrow track, but they did damage estimated at five and a half million dollars in and around Miami. The rainfall at Miami was very eccentric—0·24 in. before the arrival of the fifteen mile wide calm centre and 3·80 in. afterwards. The storm was not circular, and had some characteristics more appropriate to extra-tropical cyclones. It did not cause any very abnormal tides. The second paper, by H. R. Byers, is an attempt to relate the development of the storm to the different polar and tropical air masses present over the Atlantic at about the time of its formation. Charts are shown on which the various fronts are depicted, and a cross-section of the atmosphere from Omaha to Washington based on upper air soundings. Upper air conditions were also examined with the view of explaining the change of movement of the storm centre during the night of November 1–2; an isobaric chart for a height of 3,000 metres showed a distribution of pressure favourable for strong northerly winds, and it is concluded that these carried the centre southwards. The decay of the system set in when dry westerly winds at high levels spread gradually down to sea-level.

### Thermostats

No. 276 of the series "Actualités scientifiques et industrielles" (Paris: Hermann et Cie., 15 francs) is entitled "Les Thermostats pour les Temperatures moyennes" and is written by Dr. André Lalande. It deals in a more general manner than has been previously attempted with the conditions which make for the efficient operation of thermostats of all types, including those which depend on mercury triode valves. References to more than seventy regulators are given.

### Infra-red Sensitisers

THE effect on the sensitising properties of the cyanine dyestuffs of introducing various atoms or radicals in different parts of the cyanine molecule is of considerable interest for the possible extension of photography into the infra-red region. In a recent paper, A. Corbellini and R. Fusco (*Rendiconti del Reale Istituto Lombardo di Scienze e Lettere*, 68, 961; 1935) describe the preparation of a number of tricarbocyanines in which one of the hydrogen atoms in the seven-membered CH ring is replaced by halogen atoms. The α-halogen derivatives of glutaconaldehydedianilide hydrochloride were condensed with various heterocyclic nuclei, namely, the ethiodides of quinaldine, β-naphthoquinaldine, α-methylbenzthiazole, and methyl-α-naphthathiazole. The resulting tricarbocyanines all absorb and act as sensitisers in the infra-red, but the presence of the halogen atom in the CH chain does not influence the sensitising power.

### Radiations from Sodium and Mercury Vapour Lamps

WE welcome the first two numbers of *Philips Technical Review* published in English by the well-known Philips' lamp factory at Eindhoven in Holland, which is affiliated with Philips Lamps Ltd., of 145 Charing Cross Road, London. It deals with technical problems relating to the products, processes and investigations carried out by this firm, and judging by the early numbers it should be of value and interest to the whole engineering profession. A paper compiled by G. Heller in the first number describes how the visible radiations from sodium and mercury vapour lamps are generated. The processes in the two cases are entirely different. Sodium is excited by the impact of electrically accelerated electrons against atoms in their normal state. In general, the efficiency in light production of the sodium vapour is higher, the lower the vapour pressure, the current density and the luminous intensity. In high-pressure vapour lamps, on the other hand, the radiation is produced by the temperature of the mercury vapour. Unlike the sodium vapour lamp, the efficiency diminishes with the vapour pressure, the current density and the luminous intensity. The characteristics of a sodium tube lamp of 100 watts are compared with those of a super high-pressure mercury lamp of 1,400 watts. The sodium lamp is surrounded by a double-walled vacuum flask which diminishes heat conduction, but in the mercury lamp the vapour discharge is cooled by running water. The mercury molecules give a spectrum composed of wide bands instead of sharply defined lines. The light output of sodium and mercury lamps will be discussed further in a later issue.

### Acoustics of Telephony

THE transmission of speech over a distance involves problems of both an acoustical and an electrical nature. Normally there is but one medium, the air, between the speaker and the listener; but in order to carry the energy to a distance, the telephone engineer interposes an electrical system between the two. A brief survey, in popular language, of the acoustical characteristics of the two ends of such a telephone system forms the subject of the most recently issued of the Post Office Green Papers (No. 25). This pamphlet, entitled "Acoustics of Telephony", has been prepared by Dr. E. G. Richardson. It commences with an illustrated description of the human ear and the manner in which the voice operates to produce the sounds of ordinary speech, a circuit diagram being given of an electrical analogue of this voice. A cathode ray oscillograph equipment for the recording of speech wave-forms is described, and some typical oscillograms of vowel sounds by various speakers are shown. The importance of obtaining freedom from interference in ordinary telephony is noticed, and reference is made to the sound-absorbing properties of various materials and the principles of sound-proofing systems, such as the ordinary telephone kiosk. This interesting publication should do a good deal in directing public attention to the important progress which technical acoustics has made in recent years in connexion with the development of communications engineering.

### Telluric Acids

M. PATRY (*Bull. Soc. Chim.*, 3, 845; 1936) finds that orthotelluric acid, $Te(OH)_6$, is stable below 100°; between 100° and 220° metatelluric acid, $H_2TeO_4$, is formed. The reaction is complete in a few minutes at 200°. This loses water to form the trioxide, $TeO_3$, above 220°, and above 395° the trioxide decomposes into the dioxide, $TeO_2$. Complicated results are obtained by heating orthotelluric acid in a sealed tube. Mylius found that the acid fused at 136° in such circumstances and was converted into a soluble so-called allotelluric acid, $(H_2TeO_4)_n$. Metatelluric acid is a white amorphous hygroscopic powder, very slowly soluble in water. Tellurium trioxide is an orange yellow, non-hygroscopic powder, insoluble in water. Allotelluric acid is a viscous mass, soluble in water. It is now shown to be a mixture containing one constituent to which it owes its peculiar properties. A large proportion, unlike orthotelluric acid, is soluble in cold alcohol or nitric acid, and this part is regarded as pure allotelluric acid. In the sealed tube experiment, a grey, hard form of the trioxide, called $TeO_3(\beta)$, is formed on prolonged heating. Allotelluric acid in solution passes into orthotelluric acid; the change can be followed by the electrical conductivity.

### Optically Active Disaccharides

AMONG the carbohydrates, many examples of optical antipodes have been prepared in the monosaccharide series and in the simple glycosides of the monosaccharides. Optical antipodes among the disaccharides are theoretically possible, but were not previously described. L. C. Kreider and W. L. Evans (*J. Amer. Chem. Soc.*, 58, 797; 1936) have now prepared such antipodes, their work being based on the following principle. If a molecule of the optically inactive keto-triose, dihydroxyacetone, could be joined in true biosidic linkage with a molecule of the *d*-form of an optically active monose, a true optically active disaccharide would result. Then if dihydroxyacetone could be joined in the same manner to the *l*-form of the same optically active monose, a second optically active disaccharide would be formed which should be the exact optical antipode of the first. This has been achieved with *d*-arabinose and *l*-xylose as the monosaccharides. The compounds β-*d*-arabinosidodihydroxyacetone tetraacetate and the corresponding β-*l*-compound, β-*d*-xylosidodihydroxyacetone tetraacetate and the corresponding β-*l*-compound, and β-acetobromo-*l*-xylose, were prepared. These contain examples of the first disaccharide to have a pentose and a triose as its constituent parts and the first examples of pairs of synthetic optical antipodes among disaccharides; the first disaccharide racemate was demonstrated in the case of β-*dl*-arabinosidodihydroxyacetone tetraacetate.

# Determination of Sulphur in Organic Products

THE methods in general use for the determination of sulphur in animal and vegetable products for sulphur-balance experiments with cattle and sheep depend upon the oxidation of not more than a gram of material with copper nitrate (S. R. Benedict, 1909) or fusion with sodium peroxide (R. E. Evans, 1931). From a material like hay with a small percentage of sulphur, the amount of barium sulphate finally obtained from 1 gm. does not exceed 2·5 mgm., so that liability to error is considerable.

To overcome this disadvantage, F. J. Warth and T. S. Krishnan have devised a method in which much larger amounts of the substance can be treated, consisting in a nitric acid oxidation followed by alkali fusion, the latter step being essential for complete oxidation of the sulphur (*Ind. J. Veterin. Sci. and Animal Husbandry*, 5, Pt. 3, September 1935, p. 210). For urine, 100 c.c. may be treated with 10–15 c.c. concentrated nitric acid and slowly heated on a sand bath until gentle effervescence commences. The beaker is then removed, and the reaction allowed to proceed in the cold until complete. After re-heating, and cooling overnight, nitrophenols and hippuric acid are filtered off, the filtrate is concentrated to a small volume, rediluted and again concentrated, this treatment being repeated until dilution causes no turbidity. The yellow solution is then made up to 100 c.c., and an aliquot taken for fusion, for which 5 c.c. of 50 per cent sodium hydroxide are added, mixed, and the whole is transferred to a silver basin. The water is evaporated off, and the dry residue is heated on the sand bath and finally fused. The fusion is completed in a few minutes, resulting in a pure white melt which is dissolved in water, treated with hydrochloric acid to remove nitric acid, filtered to remove small amounts of silver chloride and silica, and is then ready for precipitation of barium sulphate in the usual way.

For foodstuffs, such as hay and cake, and fæces, 5–10 gm. of substance is oxidised with boiling nitric acid for six hours. The contents of the flask are transferred to a beaker, diluted and allowed to stand overnight. The liquid is filtered, the filtrate concentrated in a beaker to a volume of 25 c.c., covered with a watch glass, and gently boiled and concentrated, which causes further oxidation with production of brown fumes. More acid is added, if necessary, until oxidation is complete. The liquid is then cooled, diluted and, if necessary, filtered. It is then evaporated on the water-bath, 10 c.c. of 50 per cent sodium hydroxide and 1–2 gm. of potassium nitrate are added, the whole is transferred to a silver dish, dried and fused.

For some materials, for example, grass, it may be desirable to deal with 100 gm. of material. For this, 100 gm. or thereabouts is weighed into a litre beaker, 500 c.c. of dilute (1 : 3) nitric acid is added, and the whole is heated in order to start a gentle reaction. The source of heat is then removed, and the reaction is allowed to proceed to completion, with stirring. The beaker is then again heated, covered and the contents boiled vigorously for twelve hours, with addition of water to maintain the volume. The mixture is allowed to stand overnight, filtered on a Büchner funnel and thoroughly washed with nitric-acid-water. The filtrate and washings are finally made up to 2,000 c.c., and an aliquot of 100 c.c. used for the determination of sulphur by fusion.

# Pleistocene Chronology

VARIOUS lines of scientific investigation are now converging on the chronological problems of geology, prehistoric archæology and palæontology. The investigation of sedimentary deposits in Scandinavia by De Geer, and A. E. Douglass's tree-ring chronology in the south-western United States are instances in point. The application of the results of the study of solar radiation to the Pleistocene chronology of Central Europe has been reviewed by Dr. Friedrich E. Zeuner in relation to the evidence of geology, prehistoric archæology and palæontology (*Geol. Mag.*, 72, 19, 350–376; 1935).

During the last twenty years, the Pleistocene of Central Europe has been investigated by a great number of geologists, with the result that a detailed stratigraphy has been established, which is generally applicable. When the 'radiation curve' of Milankovitch is applied to this stratigraphy, it becomes possible to date exactly fossils, skeletal remains and prehistoric implements from certain localities in thousands of years.

On the evidence of the north German area of glaciation, the Alpine area of glaciation and the 'periglacial zone' (middle and south Germany), it is possible to formulate a correlation for which, as a matter of convenience, the Alpine terminology of Penck and Brückner may be used. This system of stratigraphy extends over a wide area. The Silesian Pleistocene links up the north-west and mid-German areas with Poland and Russia, while the Ukrainian loesses admit of a detailed subdivision with the same accuracy as the loess of Central Europe. In north Russia the same conditions prevail as in Germany, and the Caucasian mountains exhibit the same Pleistocene divisions. The later glacial phases (Riss and after) are thus represented in the whole of Central and Eastern Europe.

An outstanding point to emerge is that every glaciation of the old north German and Alpine divisions now appears to consist of two cold phases, which belong closely together. The Würm glaciation, however, includes a third and smaller phase. Two

cooler phases of less intensity are intercalated between Mindel 2 and Riss 1 and between Riss 2 and Würm 1. These have not yet been found outside central and south Germany. There are several cold phases older than Günz, but up to now they have only been proved for the Alps and a few river systems. They are older than the 'Diluvium', and possibly are contemporary with the earliest Pleistocene and Upper Pliocene of England.

In Milankovitch's radiation curve (all calculations are as from A.D. 1800) there are strong minima of solar radiation in a group of three at 23,000, 72,000 and 115,000 years; of two at 188,000 and 230,000 years; a long period without stronger minima of radiation stands between 240,000 and 430,000 years; there is another group of two minima at 435,000 and 476,000 years; and an early group of two minima at 550,000 and 591,000 years. It can scarcely be coincidence that this arrangement is exactly the same as was found for the glacial phases of the Pleistocene. Not only are the threefold Würm and the doubled Riss, Mindel and Günz represented by strong minima of radiation, but also the great interglacial Mindel 2–Riss 1 finds its equivalent in a period of nearly 200,000 years. The coincidence of so many details is almost amazing. An application of the curve solves many of the old problems of stratigraphy, as well as raises new.

The absolute chronology thus afforded also dates the remains of fossil man and his cultures more accurately than hitherto, but only provided their exact position in the stratigraphical succession has been determined. The most ancient find in Central Europe, *Homo heidelbergensis* from the Mauer sands, cannot be later than the interglacial between Günz 2 and Mindel 1. Many have correlated him with the Chellean, but it is not impossible to assign him a pre-Chellean culture with a place in the absolute scale of about 500,000 years. The Acheulean at Achenheim occurs in the loess of Riss 2 and falls within a glacial phase, though the evidence from Markleeberg suggests that it may extend further back, giving a possible antiquity of 183,000 years. The Mousterian stations Taubach and Ehringsdorf show that Neanderthal man was present in Germany in the last phase of the Interglacial Riss/Würm, and was still living there when the climate became colder with the advance of the Würm glaciation; while Wallertheim shows that he was there after the maximum of Würm 1. This dating indicates an antiquity covering the period from 140,000 to 105,000. The Aurignacian, on the evidence from Linsenberg near Mayence, belongs to the beginning of Würm 2 and is dated from 95,000 to 69,000 and is followed by the Solutrean of Předmost, of which the precise age has still to be determined; but it is suggested on the strength of evidence from Kesslerloch that the Solutrean stands at 67,000. The Kesslerloch Magdalenian site was inhabited some time after the maximum of Würm 2, and most German Magdalenian is of about the same period; while in north Germany (Balver Höhle, Westphalia) the end of the Magdalenian is Würm 3. The whole Magdalenian is dated at 65,000 to 18,000; while the Mesolithic, after Würm 3, is assigned to 15,000 to 7,500 and the Neolithic in the post-glacial Atlantic phase dated 7,500 to 4,000. (All dates are reckoned in years before A.D. 1800.)

In palæontology, the new chronology makes it possible to date the disappearance of ancient species and the appearance of new ones very exactly. We are enabled to study migrations and other alterations in the distribution of species with precision. For example, the hippopotamus, absent in Central Europe, except in the Rhine Valley, where it is typical of the early Pleistocene, persists into late Middle or even Upper Pleistocene in England. It can thus be shown to have survived in western Germany for a 100,000 years after it had disappeared from the rest of mid-Europe, while it survived in the oceanic climate of England for another 200,000 years longer.

The new chronology also enables us to estimate the time necessary for adaptation and other alterations of specific characters, of which the most intelligible instance is afforded by the elephants. Thus *E. antiquus*, a forest species, in 450,000 years developed very little; but in the same period *E. primigenius* shows a very marked specialisation owing to a new biotope. The Siberian mammoths may be about 15,000 years old. For the whole evolution of the mammoth the absolute chronology allows about 450,000–500,000 years. It is thus seen to afford a criterion for the speed of evolution, of which we know very little.

# Coal and Gas in Great Britain

AT the seventy-third annual meeting of the Institution of Gas Engineers in London on May 26–29, the address of the president, Colonel W. Moncrieff Carr, referred to "perhaps the most serious problem in the history of the Industry"—the proposed coal selling scheme, under which not only the prices but also the choice of gas coal would be apparently at the discretion of the coal industry, which would thus acquire uncontrolled monopolistic power. It is feared that the coal industry's policy will be influenced by a desire voiced by its spokesmen and indicated by its commercial actions to discourage the replacement of raw coal by the products of coal carbonisation, even though this conduces to public amenity and hygiene and to private convenience. Moreover, freedom of choice of raw material is vital to any manufacturing industry and especially where the raw material can be so variable as coal.

At the moment, the public gas supply is being concentrated into fewer and larger units by several paths—amalgamations of adjacent undertakings, by the establishment of 'gas grids' where local circumstances are favourable, and by the formation of holding companies controlling many but not necessarily adjoining undertakings. The merits and demerits of these activities are engaging much attention, to which a paper by Mr. F. C. Briggs on the Dudley Gas Amalgamation contributed. In south Yorkshire the coking industry produces an abundant supply of gas as a by-product which the

gas grid controlled by the Sheffield Gas Co. has made available over a wide area and at prices lower than customary. The Rotherham Corporation has also taken advantage of the local supply of coke oven gas, and in order to encourage the use of gas instead of coal has instituted a two-part tariff with a very low consumption charge (10*d.* per 1,000 cub. ft. of 500 B.T.U.). Mr. J. T. Haynes, formerly manager of the Rotherham undertaking, reported the success of the tariff, which has been adopted by consumers of all classes. The results show that, roughly speaking, 1,000 cub. ft. of gas does the work of 1 cwt. of domestic coal.

Mr. C. A. Masterman's paper on gas safety precautions contained much of interest. While considering steps to reduce the number of deaths from the use of gas, he indicated that the publicity given to such accidents creates a false impression of their frequency. Actually the fatality rate from coal gas in Great Britain is only a fraction of corresponding figures in other countries. The report of the Registrar General shows that coal gas accidents are only one fifth of those due to falling downstairs, while those due to products of combustion are insignificant. Actually ten times as many people die as a result of falling out of bed as from the fumes of burning coal gas. Nevertheless, as a result of greater care in the service of gas appliances, the number of such accidents is diminishing, while the consumption of gas increases.

The paper by J. Jameson and Dr. J. G. King on the carbonisation of cannel at Edinburgh Gas Works gave interesting results which received an undesirable publicity in the daily Press. It was shown that a certain Scotch cannel yields on carbonisation not only a good yield of gas, but also of tar particularly suited for hydrogenation to give motor-spirit and a coke quite serviceable for domestic use. Unfortunately, it has been suggested that the carbonisation of cannel could be expanded almost to cover the nation's supply of liquid fuel. This is a myth which was exploded long ago, for example, during the War. Suitable cannels, as Messrs. Jameson and King indicated, are too irregular in supply and too variable in quality to form a basis of an industry of such magnitude. It is regrettable that the Press should be used to disseminate such perversions of the results of research.

# The Carnegie United Kingdom Trust

THE Carnegie United Kingdom Trust's twenty-second Annual Report couples with its description of the work of the year 1935 a general account of progress achieved during the past five years and an outline of its five-year plan for 1936–40. Some idea of the range of the Trustees' activities during the past quinquennium can be gathered from the following summary classification of grants: libraries, £296,500 (being 44 per cent of the total of all the grants); playing-fields and play-centres, £125,000; village halls, rural community councils, new estates community associations, youth hostels and other schemes for rural development and social service, £162,600; adult education (including museums), £35,700; music and drama, £18,400; miscellaneous, £32,200.

Two big changes of policy, one negative and one positive, differentiate the current from the past five-years' programme. Libraries have enjoyed the lion's share of the grants ever since the Trust's foundation, and three-fourths of this share has gone to county and municipal libraries. Last year, however, the Trust decided that for the future these institutions might safely be left to rely upon other resources. A similar decision was reached in regard to grants for special libraries, for newly formed rural community councils and for playing-fields: ". . . in each of these fields they [the Trustees] have helped to set up a standard of achievement which should enable those who are responsible locally to carry on the work and develop it adequately, and . . . to give further help would stultify *the pioneer principle which is at the root of the policy which their founder laid down*".

It is in projects for land settlement that the Trustees have found an outlet for the funds thus set free. So long ago as 1933, they commissioned Mr. A. W. Menzies Kitchin, of the University of Cambridge Department of Agriculture, to investigate the potentialities of land settlement as an agency for social welfare, and ways and means for promoting it. His report, published last January, favours experiment along two lines: (1) co-operative smallholding schemes of 30–40 families, each holding being 3–10 acres of land; and (2) co-operative part-time subsistence holdings; and the Trustees have allocated £150,000 for schemes of these types. Already two schemes of type (1) are in being, both promoted by the Land Settlement Association, one at Potton (market garden holdings) on land given by Mr. P. Malcolm Stewart, and one at Andover (poultry and pig holdings), and the Trustees have allotted £10,000 towards the capital cost of establishing three more such schemes (forty families each) in distressed areas in co-operation with county councils. Another £10,000 is allotted towards starting thirty part-time settlements of forty men each on the group-holding (quarter to half-acre) system—an experiment recently taken over from the Society of Friends.

Another entirely new allocation is one of £30,000 for encouraging amateur choral and orchestral societies and for holding short schools for conductors. As in the case of the land settlement schemes, this new venture has not been undertaken without prolonged inquiry and consideration. It will be under the direction of a joint committee of the Trustees and a national federation of amateur societies recently set up on the initiative of the Incorporated Society of Musicians.

The whole report is extremely interesting. The Trust's activities have a value over and above their directly beneficial results in that they are often conducted in such a way as to have permanent value as pieces of scientific research.

## Educational Topics and Events

CAMBRIDGE.—Dr. L. Howarth, of King's College, has been appointed University lecturer in the Faculty of Mathematics.

J. H. Lockhead, of Christ's College, has been appointed senior curator of the Museum of Zoology.

The Benn W. Levy research studentship in biochemistry will become vacant on September 30. Applications from candidates should be addressed to Sir Frederick Gowland Hopkins at the School of Biochemistry before July 31.

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ACCORDING to the law of New York State, a licence to practise as an optician can be issued only to a person who has graduated in arts or science and in optometry at a university, and has passed the examination of the State Board. The announcement of the professional courses in optometry for the winter and spring sessions 1936–37 at Columbia University shows further that for admission to the University a candidate must have completed a four-year course of study at a secondary school in English, history, a foreign language, algebra, geometry, and either physics or chemistry. The first two years at the university are devoted to English, German, mathematics, contemporary civilisation, physics, chemistry, physiology and physical education; the third and fourth years to geometrical, physical and physiological optics and workshop practice. The work is done on the eleventh floor, of 10,000 square feet, of the Pupin Physics Laboratories of the University. The cost to a student is estimated at about 600 dollars per annum for a student living at home and 900 dollars for one living in one of the halls of residence. These are minimum figures, and do not include the cost of professional equipment, about 500 dollars, which the student would utilise in his or her practice.

IN the recent report of the University Grants Committee, suggestions were made as to the need for improvements of methods and lecture systems in the universities of Great Britain, and it is therefore timely to learn of the proposals which are being advanced in the case of one of the oldest of the American technical institutions. When addressing the alumni of the Rensselaer Polytechnic Institute on the occasion of his induction, Dr. William Otis Hotchkiss gave an outline of the plans and purposes which, as its new president, he hopes to be able to carry into effect (*R.P.I. Bulletin*, **34**, extra to No. 4, Dec. 1935). Dr. Hotchkiss takes 'efficiency' as his ideal, defining it in the best and broadest sense as the use of the time, ability and opportunity of the student, not only in the classrooms but also in the wider activities of life. The time allotted to courses should be properly proportioned between three groups: (*a*) English and other general subjects such as economics; (*b*) fundamental mathematics and science; (*c*) applied engineering subjects. While group (*a*) is necessarily distinct from the other two, it may well be objected that groups (*b*) and (*c*) should not be separated, but that the ideal to aim at is the successful blending of the two. In engineering and other technical courses, mathematical and fundamental scientific principles should be taught and developed on the most logical lines, but should also be translated, at every stage, directly into their practical applications. A course in accordance with these ideals would require new modes of presentation and of examination, no doubt; but it is in this direction alone that the most efficient use of time and energy, both of teachers and students, may be attained.

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## Science News a Century Ago

### Criminal Statistics for England and Wales

AT a meeting of the Statistical Society held on June 20, a paper was read by S. Redgrave on "Some Data on the Present State of Crime in England and Wales". The main object of the paper was to show the proportionate amount and degree of crime in the different counties of England and Wales in 1835. The numbers given only related to persons proceeded against, and not the number of offences committed. The total number of persons charged with indictable offences at the assizes and sessions in 1935 was 20,731—17,275 males and 3,456 females—being in the proportion of 1 in 631 to the population. As a result of the trials, 523 were sentenced to death, 3,629 to transportation, 9,915 to imprisonment, 58 to be whipped, 357 were fined and 242 were discharged on sureties. Of the total, 4,034 were acquitted, and 1,943 discharged without trial.

### Sunspots and Temperatures

ON June 23, 1836, *The Times* published the following note: "M. Colomb Menard de Nismes, the French astronomer, states that whenever the sun exhibits spots on its disc, its temperature becomes much colder, and that when the spots are not visible the heat is much greater, and storms are of more frequent occurrence and greater violence. Herschel also came to the same conclusion after more than 20 years observation. . . . Never have so many of these spots been observed as during the present year between February and the end of May. Up to the 22nd of April M. Menard had counted 10 and up to the 19th of May 13, and the season had been remarkable for its coldness."

### Museums and Libraries of Vienna

REFERRING to the institutions for the encouragement of science and literature at Vienna, the *Athenæum* of June 25, 1836, said: "These consist of the Imperial Museum of Antiquities, Medals and Coins, including the Egyptian collections; the Museum of Natural History; the Museum of objects specially interesting to the students of history and the arts; the Museum of Arts and Manufactures, and different collections belonging to the University, the Theresian and Chirurgical Academy. All are gratuitously accessible to the public; but certain days and hours are set apart for scientific persons who wish to examine the different collections more minutely than they are enabled to do on public days. Besides the Imperial Library . . . there is a University Library, which possesses 100,000 volumes. The fine private library of the Emperor, an heirloom in the Imperial family, is also accessible to the public. Free admission is given to every person, without any previous application, and no instances have occurred of books being purloined. . . ."

# Societies and Academies

## PARIS

Academy of Sciences, May 11 (*C.R.*, 202, 1541–1628). LÉON LECORNU: The elasticity coefficients of an anisotropic body. RICHARD FOSSE, PAUL DE GRAEVE and PAUL EMILE THOMAS: The synthesis of cyanic acid by the action of phosgene on ammonia. Phosgene and cold aqueous ammonia give urea only as a secondary product; the primary product is cyanic acid. JEAN BAPTISTE SENDERENS and JEAN ABOULENC: The action of sulphuric acid, in the gaseous phase, on alkyl chlorides and bromides. The monosubstituted derivatives give carbon, hydrochloric acid (or bromine), sulphur dioxide, carbon monoxide and dioxide. Less carbon is formed with the di- and trisubstituted derivatives. Carbon tetrachloride gives phosgene. HENRI LAGATU and LOUIS MAUME: On the possibility of variations in opposite sense and of great amplitude, in the course of the same year, for the nitrogen, phosphorus, potassium equilibrium in the leaf of a cultivated plant. GEORGES PÓLYA: The number of isomers of certain chemical compounds. EUGÈNE BLANC: The distance of two ensembles. ANDRÉ KOLMOGOROFF: The Betti groups of metric spaces. ENRICO VOLTERRA: The deformation of elastic arcs. STEPHAN SERGHIESCO: A mechanical theory of the corpuscle of light. LABARTHE, VICHNIEVSKY and MLLE. MANSON: The nature of the vibratory phenomena due to certain combustions of the fluid developed in a thermal motor. HENRI MÉMERY: A solar period of 100 years. ANDRÉ LALLEMAND: The determination in absolute values of stellar magnitudes. ALBERT ARNULF, DANIEL BARBIER, DANIEL CHALONGE and MLLE. RENÉE CANAVAGGIA: Colour temperatures and continuous absorption of hydrogen for stars of the first spectral types. MAX GELOSO: The mechanism of the electrolysis of manganese salts. NICOLAS KÜRTI, PAUL LAINÉ, BERNARD VINCENT ROLLIN and FRANZ SIMON: The appearance of ferromagnetism in some paramagnetic salts at very low temperatures. Experiments carried out with the large Bellevue magnet. Ferric ammonium alum, at temperatures below 0·03 K., behaves as a ferromagnetic body. PIERRE JACQUINOT: The Zeeman effect and Paschen-Back effect in the case of the extreme *j-j* coupling. Example of the $2p^5ns$ configurations of neon. GEORGES ALBERT BOUTRY: Talbot's law in photo-electric photometry. MARC ANTOINE FOËX: Separations by decantations of liquid layers in fused boron – alkaline earth glasses. Proof of differences in the concentration of lime and baryta in the two layers obtained after fusion of boro-lime-baryta glasses. The ratio of the densities of the two layers is constant at a given temperature for all the alkaline earth glasses. JULIEN BRÜLL: Kinetics of the hydration of some cobalt complex compounds. OSIAS BINDER and PIERRE SPACU: The substitution of water for chlorine in the cobaltidichloro-*trans*-diethylenediamine ion. JEAN LOUIS DELSAL: The polarimetric study of aluminium malate. ERNEST TOPORESCU: The preparation of sodium bicarbonate. Reply to a criticism of B. Neumann and R. Domke. JEAN VINCENT HARISPE: 2, 4-Dimethylphenylacetic acid. Its preparation starting with pinonic acid. GUSTAVE VAVON and LOUIS BOURGEOIS: The reactivity and structure of the primary fatty amines. B. BRAJNIKOV: The essential constituent of the Normandy "argile à silex". V. AGAFONOFF: The red and brown soils with carbonate crust in Tunis. A. ROBAUX: The nummulitic Flysch on the Malaga (Andalusia) transversal. JEAN CHEVRIER: Relations between the electrical conductivity of the air and some meteorological factors at the Observatory of Ksara (Liban). The electrical conductivity of the air was found to increase with the temperature, to diminish as the relative humidity increased. The effects of pressure changes were irregular, with a tendency to a fall in conductivity as the pressure increased. NICOLAS P. PÉNTCHEFF: The proportion of neon in natural gases. Studies of the rare gases obtained from a spring at Kovanlik, Bulgaria. JEAN PIVETEAU: An ancestral form of the tailless amphibians in the lower Trias of Madagascar. ANDRÉ EICHHORN and ROBERT FRANQUET: Chromosomic numeration and nuclear evolution in *Koelreuteria paniculata*. MLLE. FERNANDE FLOUS: Polyphyletism in the Abieteæ. JEAN GIAJA and STEFAN GELINEO: Barometric pressure and resistance to cold. The resistance to cold of the rat is reduced when the pressure is reduced to that corresponding to an altitude of 2,000 metres. If the animal is protected against cold, its body temperature can be maintained at much lower pressures. LOUIS LAPICQUE: Remarks on the preceding communication. A warning that the results cannot be applied to man, on account of the difference in size. MLLE. MARIE LOUISE VERRIER and RAYMOND PANNIER: Researches on the composition of the retinal purple and its relations with the visual cells. JEAN RÉGNIER and ANDRÉ QUEVAUVILLER: The influence of the suppression of electrolytes, in preservative liquids, on the values of the excitability parameters and on the resistance to the galvanic current of the motor nerve of *Rana esculenta*. RICHARD JAHIEL and MME. SIMONE DELAUNEY: The difference of the action of the polypeptides according to their mode of introduction into the organism. The toxicity of the polypeptides depends on the mode of introduction into the organism. Small repeated daily injections have no toxic effect, but under the conditions of experimental anaphylaxy the toxic effect is large. LOUIS C. MAILLARD and JEAN ETTORI: The distribution of titanium in the organs of man. The amounts of titanium found in eighteen organs are given: no general conclusions can be drawn from the data. GUSTAVE GUITTONEAU and MLLE. JEANNE BRIGANDO: Resistance to staining acquired by heating of certain microbial bodies in milk. PIERRE LÉPINE and MLLE. VALENTINE SAUTTER: The existence in France of the murin virus of lymphocytary chorio-meningitis. ALEXANDRE BESREDKA and LUDWIK GROSS: The nature of the immunity in rabbits vaccinated against epithelioma.

## MOSCOW

Academy of Sciences (*C.R.*, 1, No. 5, 1936. I. VINOGRADOW). A new improvement of the estimation of trigonometrical sums. N. G. CHUDAKOV: Zeros of the function $\zeta(s)$. D. L. SHERMAN: A contribution to the method of N. I. Muschelishvili on the problem of elasticity theory. S. BACHALOV: A couple of congruences. N. MOISEJEV: Probability of stability according to Liapunoff. E. K. ZAVOISKIJ and B. M. KOZYREV: Changes of absorption of weak electric fields of high frequency in certain substances as a function of the strength of these fields (2). V. V. SCHULEJKIN: Origin of the periodic variations of the

regime of Atlantic currents. N. N. MALOV: Measurements of resistance of human bodies, and its connexion with the strength of the current over a wide range of frequencies. K. MISUTCH: Collateral oxidation processes during reduction of nitrogen compounds of the aromatic series. *Role of a salt of bivalent iron in the reduction process.* A. J. CHARIT and N. V. CHRUSTOV: Flavins and metabolism (5). The effect of the introduction of alloxan and thymonucleic acid into the food of rats on the flavin content in their liver. N. LAZAREV: Distribution in the blood and the intensity of action of anæsthetics. D. KOSTOFF: Studies on polyploid plants (13). Haploid *Nicotiana rustica*. B. VASILJEV: A haploid plant of durum wheat, *Triticum durum* Desf.

### SYDNEY

Royal Society of New South Wales, April 1. H. FINNEMORE, S. K. REICHARD and D. K. LARGE: Cyanogenetic glucosides in Australian plants. (3) *Eucalyptus cladocalyx*. It is shown that these leaves, which have long been known to be fatal to animals and to be cyanogenetic, contain as much as 0·6 per cent of hydrocyanic acid, the whole of which may be liberated by autolysis. The acid occurs in the form of the glucoside prunasin, previously found by Finnemore and Cox in *Eremophila maculata*. A simplified process for its isolation is now described. The powdered leaves are percolated with cold acetone, the acetone extract washed with petroleum ether, the purified residue extracted with boiling ethyl acetate, from which the glucoside separates on cooling, especially if a little chloroform be added to the solution. The yields are very good. R. D. WILSON: A bacterial disease of snake beans. The occurrence of a bacterial disease of snake beans (*Vigna sesquipedalis*) in New South Wales in 1935 is recorded. The results of comparative studies between the causal organism and cultures of the cowpea spot, lilac blight and citrus pit organisms are given. Differences were observed only in the fermentation of raffinose and in the degree of pathogenicity to various hosts. It is proposed that the snake bean pathogen should be designated *Bacterium syringae* (van Hall) E. F. Smith. A 'rough' strain of the snake bean pathogen is described. The disease was shown to be seed-borne. ADOLPH BOLLIGER: A new reaction for the determination of creatinine. A ten per cent solution of 3·5 dinitro-sodium-benzoate and normal sodium hydroxide are added to the fluid to be examined. If creatinine is present in a concentration of more than 5 mgm. per cent, immediately after adding the sodium hydroxide a purple colour will appear which deepens considerably on further standing. After about 15 minutes, the colour will change towards red or pink, and will ultimately become yellow. If the concentration of creatinine is less, it will take 5–15 minutes for the colour to appear. The colour reaction can be used, with a colorimeter, for quantitative estimation of creatinine.

### WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **22**, 195–247, April 15). FRED L. WHIPPLE and CECILIA PAYNE GAPOSCHKIN: On the bright line spectrum of Nova Herculis. On July 4, 1935, two components were observed. Spectrographically, certain lines were doubled, corresponding to the two components. It is considered that two gaseous masses of low density were ejected from the central star; the former give rise to the doubled bright lines and the latter to the continuous background. CARL D. LARUE: Tissue cultures of spermatophytes. Pieces so small as 0·5 mm. in length from immature embryos of dandelion, ox-eye daisy, wild lettuce and tomato have been grown in culture to complete plants. It is believed that it is important to use tissue which has recently been differentiated; the presence of growth hormone (auxin) and agar-agar with the nutrient solution also favour growth. LINUS PAULING and CHARLES D. CORYELL: The magnetic properties and structure of hæmoglobin, oxyhæmoglobin and carbonmonoxyhæmoglobin. Magnetic measurements show that oxy- and carbonmonoxyhæmoglobin contain no unpaired electrons (free oxygen has two); hence oxygen undergoes a profound change in electronic structure on attachment to hæmoglobin. New nomenclature, based on recent data, is suggested for hæmoglobin and related compounds. HANS BAUER: Structure and arrangement of salivary gland chromosomes in *Drosophila* species. W. E. CASTLE: Further data on linkage in rabbits. Crossover percentages for the two linked genes for rex (short coat) and also for the three linked genes, albinism, yellow fat and brown pigmentation, have been determined. Crossing-over in one region of a chromosome 'interferes' with crossing-over in another region, as in *Drosophila*. LEONARD M. BLUMENTHAL: The metric characterisation of a class of spaces. NORMAN LEVINSON: On the non-vanishing of certain functions. W. W. COBLENTZ and R. STAIR: The evaluation of ultra-violet solar radiation of short wave-lengths. The most recent method employs a titanium photo-electric cell calibrated against a standard of ultra-violet radiation. A radiant flux is observed, by this and older methods, almost twice as large as that calculated from early observations of the ultra-violet spectral energy curve. The average intensity of ultra-violet solar radiation of wave-length 3132 A. and less in the clearest midsummer weather at midday in Washington, D.C., is 75 microwatts per cm.$^2$; the corresponding figure for San Juan (there is less ozone in the stratosphere at the tropics) is 95 microwatts per cm.$^2$. Extrapolation of all the data indicates an intensity of 600 microwatts per cm.$^2$ outside the solar atmosphere; this is a 5–8-fold increase, as compared with a 20–30 per cent increase in total solar intensity of all wave-lengths. A. A. ABRAMOWITZ: The double innervation of caudal melanophores in *Fundulus*. A large group of fish, in each of which a band of melanophores was denervated by an incision in the tail, was kept in an illuminated black tank for a fortnight. Each fish was then removed periodically to a white background for 10 minutes or stimulated electrically, and the melanophore condition recorded photographically under the microscope. The fish was replaced on a black background for 10 minutes and the same area rephotographed. Some cells showed full contraction but not full expansion, others neither contraction nor expansion, suggesting regeneration of two sets of nerves, discrete and opposite in action. ROSS G. HARRISON: Relations of symmetry in the developing ear of *Amblystoma punctatum*. Axes of symmetry become fixed at different stages, at which also other tissue determinations occur. W. G. CLARK: Errata to the paper "Note on the effect of light on the bioelectric potentials in the *Avena* coleoptile" (NATURE, Feb. 29, 1936, p. 373).

## Forthcoming Events

### Thursday, June 25

ROYAL SOCIETY, at 4.30.—Prof. F. S. Kipping, F.R.S.: "Organic Derivatives of Silicon" (Bakerian Lecture).

ASSOCIATION OF TECHNICAL INSTITUTIONS, June 26–27.—Annual Summer Meeting to be held at Bath.

## Official Publications Received

### Great Britain and Ireland

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1935; with Report and Notes of the Director, Rev. J. P. Rowland. Pp. xx+46. (Blackburn: Stonyhurst College Observatory.) [195

Conference of Empire Survey Officers, 1935. Report of Proceedings. (Colonial No. 111.) Pp. vi+377+36 plates. (London: H.M. Stationery Office.) 20s. net. [195

Department of Scientific and Industrial Research. Forest Products Research Records, No. 9 (Wood Preservation Series, No. 2): Methods of Applying Wood Preservatives. Part 1: Non Pressure Methods. By J. Bryan. Pp. 17. (London: H.M. Stationery Office.) 6d. net. [195

Technical Publications of the International Tin Research and Development Council. Series A, No. 36: Factors Influencing the Rate of Attack of Mild Steels by Typical Weak Acid Media. By Dr. T. P. Hoar and D. Havenhand. Pp. ii+27. Free. Series A, No. 37: Methods of Detinning Tinplate for Examination of the Thickness and Continuity of the Alloy Layer. By A. W. Hothersall and W. N. Bradshaw. Pp. ii+10. Free. Series A, No. 38: A Study of the Origin of Porosity in the Tin Coating of Tinplate. By A. W. Hothersall and J. C. Prytherch. Pp. ii+15. Free. (London: International Tin Research and Development Council.) [205

Rubber Latex. By Dr. Henry P. Stevens and W. H. Stevens. Fourth edition. Pp. 224+11 plates. (London: Rubber Growers' Association.) [215

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Fifteenth Annual General Meeting on May 20th, 1936. Pp. ii+65. (London: Empire Cotton Growing Corporation.) [215

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1936. Pp. 62+8 plates. (Edinburgh: Zoological Society of Scotland.) [215

Royal Observatory, Edinburgh. Forty-sixth Annual Report of the Astronomer Royal for Scotland, 1935. Pp. 8. (Edinburgh and London: H.M. Stationery Office.) 2d. net. [215

British Trust for Ornithology. Second Report, Spring 1936. Pp. 24. (London: British Trust for Ornithology.) [225

Ministry of Health. Costing Returns: Year ending 31st March 1935. Part 2: Poor Law Institutions; Separate Casual Wards. Pp. 27. (London: H.M. Stationery Office.) 1s. 3d. net. [225

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1935. Pp. 63+2 plates. (London: H.M. Stationery Office.) 1s. net. [225

The University of Leeds: Department of Leather Industries. Report of the Advisory Committee on the Work of the Department during the Sessions 1928–29 to 1934–35. Pp. 11. (Leeds: The University.) [255

The British Science Guild. Gabrielle Howard Memorial Lecture: Telegraphs and Telephones. By Prof. W. L. Bragg. Pp. iv+48+3 plates. (London: British Science Guild.) [265

The Scientific Journal of the Royal College of Science. Vol. 6: containing Papers read during the Session 1935–1936 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 136. (London: Edward Arnold and Co.) 7s. 6d. [265

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 1: Pneumatic Equipment for Farm Tractors. By Alexander Hay. Pp. 18. (London: Rubber Growers' Association.) Free. [275

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1934. Part 2. Pp. iv+65+4 plates. (London: H.M. Stationery Office.) 1s. 6d. net. [275

### Other Countries

Iwata Institute of Plant Biochemistry. Publication No. 2: Katalytische Wirkungen der Metallkomplexverbindungen. Von Prof. Koita Shibata und Prof. Yuji Shibata. Pp. xiv+219. (Tokyo: Maruzen Co., Ltd.) 2.50 dollars. [155

Canada: Department of Mines: Mines Branch. Analyses of Canadian Crude Oils, Naphthas, Shale Oil and Bitumen. By P. V. Rosewarne, H. McD. Chantler and A. A. Swinnerton. (No. 765.) Pp. vi+21. (Ottawa: King's Printer.) 10 cents. [185

Norske Videnskaps-Akademi i Oslo. Geofysiske Publikasjoner, Vol. 14, No. 1: Mittel und Extreme der Lufttemperatur. Von B. J. Birkeland. Pp. 155. (Oslo: Grøndahl and Søns Boktrykkeri.) 15.00 kr. [185

Industrial Development in South Africa and Facilities for the Establishment of Factories. (Published by the Department of Commerce and Industries.) Pp. xvi+235. (Pretoria: Government Printer.) 1s. [195

Organon: International Review. Vol. 1. Pp. vii+304. (Warsaw: Mianowski Institute for the Promotion of Science and Letters.) [185

Observatoire de Paris: Section d'Astrophysique à Meudon. Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure. Par L. D'Azambuja. Vol. 1, Fasc. 4, Année 1934. Pp. 32. (Meudon: Observatoire de Paris.) [215

Royal Agricultural Society, Egypt. Bulletin No. 24 of Technical Section and No. 2 of Royal Agricultural Society and Imperial Chemical Industries, Ltd. Joint Agricultural Research Scheme: Experiments in Egypt on the Interaction of Factors in Crop Growth. 2a: Residual Effects of Nitrogenous Manuring and Spacing of the Cotton Crop on the Following Wheat Crop; 2b: Inter-relation of Nitrogenous Manuring, Variety and Spacing for the Wheat Crop. By Dr. Frank Crowthe Pp. 35. (Cairo: Royal Agricultural Society.) [2

State of Connecticut. Public Document No. 24: Fifty-eig Report of the Connecticut Agricultural Experiment Station, N Haven, for the Year 1934. Pp. xii+718. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [225

Bulletin of the American Museum of Natural History. Vol. 71: The American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name. Pp. vii+535. (New York: American Museum of Natural History.) [225

Conseil International des Unions scientifiques. Quatrième rapport de la Commission pour l'étude des relations entre les phénomènes solaires et terrestres. Pp. 159. (Firenze: Conseil International des Unions scientifiques.) [225

Smithsonian Miscellaneous Collections. Vol. 95, No. 5: Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum*, and Species confused with Them. By Paul Bartsch. (Publication 3384.) Pp. ii+60+8 plates. (Washington, D.C.: Smithsonian Institution.) [255

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 15: Reorganization of School Units; a Report of the Proceedings of a Conference called by the Commissioner of Education, Washington, D.C., June 17, 18 and 19, 1935. Edited and compiled by Katherine M. Cook. Pp. iii+91. 10 cents. Bulletin, 1936, No. 18–II: Youth—Leisure for Living. By Katherine Glover. Pp. vii+126. 15 cents. (Washington, D.C.: Government Printing Office.) [255

Canada: Department of Mines: Mines Branch. Petroleum Fuels in Canada: Deliveries for Consumption, Calendar Year 1934. Prepared by John M. Casey. (No. 772.) Pp. ii+20. (Ottawa: King's Printer.) 10 cents. [255

Indian Forest Records (New Series). Vol. 1, No. 2: A Study of the Soils in the Hill Areas of the Kulu Forest Division, Punjab. Part 1: An Investigation of Soil-Profiles under Deodar, Spruce, Blue Pine and Chir. By E. McKenzie Taylor, I. D. Mahendru, M. L. Mehta and R. C. Hoon. Pp. 289–346+3 plates. (Delhi: Manager of Publications.) 2.2 rupees; 4s. [255

Stanford University Publications: University Series. Biological Sciences, Vol. 2, No. 8: Contributions toward a Monograph of the Sucking Lice, Part 8. By Prof. Gordon Floyd Ferris. Pp. 108+3 plates. 1 dollar. Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 6: A Report on several Species of *Lycium* from the Southwestern Deserts. By Ira L. Wiggins. Pp. 195–206+2 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) [255

Union of South Africa: Department of Agriculture and Forestry. Bulletin No. 155 (Chemistry Series No. 142): The Rising of Fat in Milk in the Course of Delivery. By Dr. L. Denis-Lester. Pp. 6. Bulletin No. 157 (Chemical Series No. 144): Influence of Period of Lactation on the Freezing Point of South African Milk. By Dr. L. Denis-Lester. Pp. 8. (Pretoria: Government Printer.) [255

Union of South Africa: Department of Mines: Geological Survey. The Geology of Ventersdorp and adjoining Country: an Explanation of Sheet 53 (Ventersdorp). By Dr. Louis T. Nel, H. F. Frommurse, J. Willemse and Dr. S. H. Haughton; with a Chapter on the Diamondiferous Alluvials, by Dr. A. L. du Toit. Pp. 102. (Pretoria: Government Printer.) 5s., including Map. [265

Proceedings of the United States National Museum. Vol. 83, No. 2988: Notes on the Butterflies of the Genus Enodia and Description of a New Fritillary from Peru. By Austin H. Clark. Pp. 251–259. (Washington, D.C.: Government Printing Office.) [275

U.S. Department of Agriculture. Technical Bulletin No. 498: The Flour Beetles of the Genus Tribolium. By Newell E. Good. Pp. 58. (Washington, D.C.: Government Printing Office.) 10 cents. [275

Smithsonian Miscellaneous Collections. Vol. 95, No. 6: New Species of American Edrioasteroidea. By R. S. Bassler. (Publication 3385.) Pp. 33+7 plates. Vol. 95, No. 7: The Gold-Banded Skipper (*Rhabdoides cellus*). By Austin H. Clark. (Publication 3386.) Pp. 50+8 plates. (Washington, D.C.: Smithsonian Institution.) [275

### Catalogues

Books and Manuscripts on Genealogy, Heraldry, Archæology, Architecture, Armour, Brasses, Cathedrals, Charters, Domesday, Maps, Mediæval History, Numismatics, Place-Names, Records, Stained Glass, Views, etc., embracing the Genealogical and Heraldic Portion of the Library of the late W. Bruce Bannerman. (No. 201.) Pp. 36. (Leicester: Bernard Halliday.)

A Supplement of Scientific Books. No. 1. Pp. 24. (Cambridge: W. Heffer and Sons, Ltd.)

Dr. Ashworth's Ultra-Violet Ray Meter. Pp. 2. (London: Negretti and Zambra.)

The New Hilger Wavelength Spectrometer: with a Complete Range of Co-ordinated Accessories forming Spectrometers, Spectrographs, Monochromators and Spectrophotometers for the Visible, Ultra-Violet and Infra-Red. (Publication No. 241.) Pp. 64. (London: Adam Hilger, Ltd.)

The Educational Focus. Vol. 7, No. 2, June 1936. Pp. 24. Bausch and Lomb Magazine. Vol. 12, No. 2, May 1936. Pp. 24. (Rochester, N.Y.: Bausch and Lomb Optical Co.)

Watson's Microscope Record. No. 38, May 1936. Pp. 24. (London: W. Watson and Sons, Ltd.)

Zeiss Nachrichten. Heft 10, Januar 1936. Pp. 48. (Jena and London: Carl Zeiss.)

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No. 3478 SATURDAY, JUNE 27, 1936 Vol. 137

# The Centenary of the University of London

DURING the week June 29–July 3 will be celebrated the centenary of the University of London. The granting of its first Charter in 1836 by H.M. William IV was an important landmark not only in the history of education but also in the history of science itself. It must be remembered that, in the early nineteenth century, England had only the two Universities of Oxford and Cambridge, and these "kept the noiseless tenour of their way", steeped in the traditional policy of medieval times and paying little attention to the new sciences which were then arousing the interest and enthusiasm of many men whose names were destined to be world-famous. Limited in curriculum for the most part to the study of mathematics and the classical languages, restricted in membership to those who subscribed to the doctrines of the Established Church, the older universities seemed to stand for all that was conservative and reactionary. The movement for a new university was one aspect of the general attack on privilege which resulted in the Reform Act of 1832 and the social and legal reforms associated with the names of Bentham and Brougham.

The establishment of the 'godless' University College at Gower Street in 1827 was regarded not only with derision but also with alarm. Many public men were seriously concerned at the growth of the new 'liberal' spirit, and grave doubts were expressed in Parliament, in the Press and elsewhere as to the desirability of encouraging such an institution. The struggle for recognition was long and bitter, but eventually the Government was forced to give way, and the University of London came into being. Even then, it was only a compromise: the new University was constituted solely as an examining and degree-giving body, and the teaching was entrusted to the two Colleges, University and King's, which were already in existence. The despised infant, unwanted and debarred from its full rights, nevertheless thrived well, and soon began to show a lively interest in the new sciences. This was no doubt due to the composition of the Governing Body, which included some of the most eminent men of the Victorian age. The Charter of 1836 nominated as fellows and members of the Senate no less than fifteen fellows of the Royal Society, among whom were Airy—the Astronomer Royal—Neil Arnott, Francis Beaufort, John Shaw Lefevre, Peter Mark Roget, Nassau Senior. Michael Faraday, especially, played a prominent part in the affairs of the University for nearly thirty years. There was no lack of such men to carry on their policy: later there occur in the minutes of the Senate the names of Hooker, Huxley, Lister, Paget, Sharpey, Foster and Ray Lankester.

Under the guidance of these eminent men, the examination curriculum was established on a broad and truly liberal basis: and a high standard was set and maintained. Recognition was accorded to subjects previously either neglected or completely ignored, such as English, history, modern languages, chemistry. The pioneers justified the inclusion of these, not only as subjects worthy of study in themselves but also as providing a training for the mind equally as beneficial as that claimed for the more ancient studies. What Arnold of Rugby achieved for the Faculty of Arts, Faraday and others did for the Faculty of Science. A momentous step was taken when in 1860 degrees in science were instituted for the first time in England, and academic recognition thus obtained

for the scientific teaching which was being carried on in London and the provinces.

In medicine, too, great emphasis was from the beginning laid upon the necessity of adequate study of the pre-clinical sciences, and this did much to raise the standard of medical education—a sorely needed reform. Doctors of science were required to present a thesis which should stand the regulation test of the Royal Society and be judged to contain to some extent "an addition to knowledge". The graduates themselves took a keen interest in matters of educational policy. They procured the recognition of the London medical degree as a licence to practise; and a resolution of Convocation in 1878 urged that encouragement should be given to the "cultivation of such higher and less usual branches of study as can be more conveniently or more efficiently taught by a central body". To the very extent of its power, the University fostered the advancement of science, but its influence was, from the nature of things, only indirect. It had indeed one research institute, the Brown Institution, founded in 1871, and the names of successive professor-superintendents—Burdon-Sanderson, Horsley and Sherrington—are an eloquent tribute to the pioneer nature of its work.

In the colleges and institutions from which the University drew its candidates were many other leaders of science. University College established the first chemical and engineering laboratories in England. Chairs were established in geology, botany and zoology: the School of Anatomy and Physiology was made famous by Sharpey and his pupils, Michael Foster and Burdon-Sanderson. At King's College, founded in 1829 as the Tory counterblast to the Whig institution in Gower Street, the professoriate included Sir Charles Lyell, Charles Wheatstone, Clerk Maxwell, and later Lister himself. The great group of institutions founded in 1851 at South Kensington (later to be known as the Imperial College) was a pioneer in the teaching of science and technology, and reveres the names of Huxley, Tyndall and Unwin. For about sixty years, the University performed its function as an examining body. Though limited in scope, its influence on the development of secondary education in England (through the famous matriculation examination) was profound. On higher education, also, its influence was no less widespread and lasting, for to many of the provincial university colleges London acted as a sort of foster mother; and their students entered for the London examinations until they themselves became fully-fledged universities.

As the nineteenth century drew to a close, there came the growing realisation that neither the University nor the teaching institutions it served were getting the fullest benefit from the existing relationship. After much debate and the deliberations of two Royal Commissions, a new constitution was granted in 1900. The University now took on all the functions of a teaching university. The existing institutions of university rank became Schools of the University, and then at last began the process of co-ordinating and unifying their vast resources. University and King's College, with their long and illustrious record of scientific achievement, were joined by the newly reorganised Imperial College, by the pioneer women's colleges such as Bedford and the London School of Medicine for Women, and by the medical schools attached to the great hospitals of the Metropolis. To these were later added several Schools devoted mainly to post-graduate study and research.

The last thirty years have seen an unprecedented advance in scientific knowledge and its practical application, and the University has had constantly to adjust itself to meet the growing demands upon it. New degrees and diplomas have been instituted, new subjects have been included in the curriculum. Chairs have been established in such diverse subjects as eugenics, aeronautics, social biology, chemical engineering, etc. The provision of scholarships and research funds and of spacious and well-equipped laboratories is the constant concern of the University and its Schools, which now possess some of the finest and most up-to-date laboratories in Great Britain. By the development of such specialised institutions as the London School of Hygiene and Tropical Medicine and the British Postgraduate Medical School, London is rapidly becoming a centre for advanced teaching and research for Europe and the Empire.

Delegates from universities and learned societies throughout the world will assemble in London to take part in the official celebrations of the centenary. Those from the United States include Prof. G. D. Birkhoff, dean of the Faculty of Arts and Science at Harvard, Prof. L. P. Eisenhart from Princeton, Prof. W. G. Whitman, head of the Department of Chemical Engineering at the Massachusetts Institute of Technology, Prof. H. Bateman of the California Institute of Technology, and Dr. R. E. Swain, chairman of the School of Physical Sciences at Stanford University. Distinguished

European men of science who are coming over include Dr. Jaroslav Heyrovský, who will represent the Charles University of Prague, the Bohemian Royal Society of Sciences and the Czech Academy of Sciences and Arts; Prof. Sem Saeland, Rector of the University of Oslo, who will represent also the Norwegian Academy of Sciences; Dr. Nils Svedelius, professor of botany in the University of Uppsala, and representative of the Royal Swedish Academy of Sciences and the Royal Society of Sciences, Uppsala; M. Jean Perrin, president, and M. Charles Fabry, of the Paris Academy of Sciences; Prof. P. Zeeman, Rector of the University of Amsterdam, and Dr. J. Huizinga, of the Royal Academy of Science, Amsterdam.

The celebrations include a special service at St. Paul's Cathedral, to be followed by a luncheon at the Guildhall given by the City Corporation. Evening receptions will be given by the Government and the London County Council. The Schools of the University will extend hospitality and be open to inspection by the University's guests. At a reception to be given by the University, honorary degrees will be conferred on a number of eminent men. The degree of doctor of science will be conferred on Sir William Bragg, president of the Royal Society, on Prof. Albert Einstein and Prof. Max Planck in recognition of their great contributions to physical science, and on Prof. Johan Hjort, professor of marine biology at the University of Oslo and an outstanding scientific representative of the Scandinavian peoples. Sir Joseph Larmor, the distinguished mathematician, will receive the degree of doctor of laws, and Mr. H. G. Wells, who is a former student of Imperial College and who has done so much to promote interest in science and the scientific spirit through the medium of his pen, will become a doctor of literature. In honouring these men by admission to its society, the University adds lustre to its already brilliant record of service and achievement in the cause of science and learning.

# The Work of William B. Hardy

**Collected Scientific Papers of Sir William Bate Hardy, Fellow of the Royal Society, Fellow of Gonville and Caius College, Cambridge**
(Published under the auspices of the Colloid Committee of the Faraday Society.) Pp. xi+922 +15 plates. (Cambridge: At the University Press, 1936.) 63*s*. net.

IN a short preface Prof. Eric K. Rideal states that this volume of collected papers is published under the auspices of the Colloid Committee of the Faraday Society, but omits to mention that the Committee undertook this task at his suggestion. Contributions to the cost have been made by the Dominion Governments of Australia, South Africa and New Zealand; the master and fellows of Gonville and Caius College; the Royal Society and the Chemical, Biochemical, Physiological and Faraday Societies. The Cambridge University Press has produced the work in a style conforming to its usual high standard.

The contents of the volume fall into three very distinct groups: papers on physiological and histological subjects; papers on the fundamental problems of the colloidal state; and papers on the 'boundary state', that is, on the behaviour of liquids and solids at the interfaces between the two.

It is undoubtedly Hardy's work on colloids which has made his name familiar to the largest number of readers. The question of what led him to take up these researches is answered epigrammatically by the master of his college in a remark quoted in the preface: "Hardy once observed a cell divide under the microscope, and wondered why". If the elucidation of this process was his ultimate aim, the first steps towards it led him away from living matter. Dissatisfied with the prevailing views on protoplasm, based partly on *a priori* grounds and partly on brutal methods of staining and fixation, he investigated simple colloidal solutions. He established the connexion between electric charge and stability; clearly recognised the globulins as types of 'colloidal electrolytes', and went a considerable way towards elucidating the reversible sol-gel transformation. These investigations laid a great part of the foundations of modern colloid science, and the concept of the colloidal electrolyte in particular has been greatly extended by subsequent workers.

In view of the suggested stimulus to these researches, it is interesting to read Hardy's two addresses on "Living Matter", delivered in 1916 and 1928 respectively. In the first of these, parallels between processes in living matter and in

colloidal systems are still numerous, while the keynote of the second is a passage which must have chilled the audience (the Colloid Symposium at Toronto): "—let me state a belief which I have held for thirty years or more. It is that nothing is to be gained by claiming living matter as colloidal".

Since Hardy held this belief during the whole period of his work on colloids, it is obviously not disappointment in its outcome which induced him to turn to another set of problems: the effects on static friction between solid faces of films of lubricant "—when the solid faces are near enough together to influence directly the physical properties of the lubricant. What Osborne Reynolds calls 'boundary conditions' then operate, and the friction depends not only on the lubricant, but also on the chemical nature of the boundaries".

Investigations carried out with very simple means, yet with the most stringent exclusion of all sources of error, established two fundamental propositions: first that "resistance to slipping is due to cohesion even when a lubricant is present, and that a lubricant decreases friction by partly or wholly masking the cohesive forces of the solid; the second that a lubricant maintains its position against the normal pressure because its surface energy is a function of the thickness of the layer".

Hardy's researches, however, did much more than elucidate the effects of lubricants on static friction. By using friction—if the metaphor be permitted—as an indicator, he made the first complete study of films on solid surfaces and established the perfect continuity between their properties and those of liquid films on liquids, which are amenable to more direct methods of investigation and have been the subject of a vast volume of research.

It is highly characteristic that the first impetus to these researches was supplied by a trivial piece of domestic experience quoted by Lord Rayleigh: that tea cups would not slip on saucers wetted with water. Slight as the matter is, it gives rise to some reflections. No one will wish to imitate bad examples by talking of 'English' science, but no one familiar with history can fail to remember that Hardy's whole procedure—the discovery of a problem in a set of facts either familiar or overlooked, its formulation, its investigation by new methods and the final demonstration of its unforeseen scope—has been that of a long line of English men of science. It may be a matter of taste or prejudice if one prefers their work to that of men who (to misquote Swift) consider themselves benefactors of the species for having made two methyl groups grow where only one grew before, and who report on these repeated labours in long strings of papers. There can, however, be little doubt that the papers written by the first-named group make the more attractive reading. What Hardy says of an old author applies to many of his writings: "His discussion is worth reading. It has the spacious dignity and charm which the hurry and specialisation of to-day have of necessity banished from scientific papers".

It is a piquant question whether they would ever have seen the light if Hardy had been a member of a foreign academy. One can scarcely imagine such a body receiving a paper on friction from a man who had achieved membership as a biologist with anything but a stern "Ne sutor ultra crepidam". But they are fortunately available, and those who still can spare time for reading original papers, even though their matter has long ago passed into text-books, will find plenty to repay them in the present volume. E. H.

# Birds of Beauty above Southern Seas

**Oceanic Birds of South America:** a Study of Species of the Related Coasts and Seas, including the American Quadrant of Antarctica, based upon the Brewster-Sanford Collection in the American Museum of Natural History. By Robert Cushman Murphy. Vol. 1. Pp. xxiv + 640 + 38 plates. Vol. 2. Pp. 641–1245 + plates 39–72. (New York: American Museum of Natural History, 1936.) 10.50 dollars.

THIS handsome and valuable work, published in two volumes, describes the appearance and habits of ocean birds of the southern hemisphere; birds which spend their lives normally on the high seas, often at a great distance from the land to which they must periodically return to reproduce their species. Most of the birds described are unknown in British or even European waters, yet the habits and forms of not a few of them are akin to those of the ocean birds of the northern hemisphere, and in him who reads these volumes must arise the longing for an opportunity to voyage to those distant seas and lonely sun-drenched isles where these birds of beauty and grace have their home.

The first volume deals partly with the field work which has made possible the writing of the book. There is a full account of the geographical

background, and a most interesting section on ocean currents follows. The scope of the work may be realised from the places described. An imaginary circumnavigation of South America allows the reader to visit the Atlantic equatorial islands and the Atlantic sub-tropical islands. He then sails to the Atlantic sub-antarctic islands (the Falklands, Gough Island, Tristan da Cunha); to the Scotia Arc (South Georgia, the South Sandwich Islands, the South Orkneys and the South Shetlands), and to lonely and tempestuous Bouvet Island. After experiencing the rigours of the Antarctic, he rejoices in imagination when he is piloted to the Pacific sub-tropical islands of Juan Fernandez and others. In the section of the work dealing with the desert coast of South America he learns something of the wonders of the Guano Islands and their birds. The Galapagos Islands are described, and we are told that these islands are visited regularly by migrants from the north—the osprey, for example, and the swallow. The elusive island of Malpelo in the tropical Pacific bight "looming like a black iceberg" from ocean deeps gives sanctuary to sea birds of several species which "swarm above the unattainable summit" and which to this day have never been identified.

Part 2 of the work deals in detail with the ocean birds of the vast area described. This volume is most valuable since it is either first-hand information written with accuracy and vividness by Dr. Murphy himself, or descriptive accounts quoted from the writings of other careful observers.

An inspiring passage on St. Paul's Rocks is quoted here:

"I never properly realised the strength of an ocean current until I saw the Equatorial Current running past St. Paul's Rocks. Ordinarily at sea the current of course does not make itself visible in any way: one merely has its existence brought to one's notice by finding at midday, when the position of the ship is made known, that the ship is 20 miles or so nearer or farther from port than dead reckoning had led one to suppose she would be, and one is correspondingly elated or depressed. But St. Paul's Rocks is a small fixed point in the midst of a great ocean current, which is to be seen rushing past the rocks like a mill-race and a ship's boat is seen to be baffled in its attempts to pull against the stream."

Again, we read:

"These Rocks lie in an ocean which is prevailingly stormless and cloudless, except during the brief tempests of the doldrum season. During even calm weather, however, they are usually beset by strong surf, which splashes them with spray to their summits and tends not only to wash away the guano of the seabirds, but also to cause it to precipitate its salts in the form of a dense, shining, glassy layer. . . . So far as I can determine the resident birds are confined to three species, namely, the Brown Booby (*Sula lucogaster*) and both of the Atlantic noddies (*Anoüs stolidus* and *Anoüs minutus*)."

Moseley of the *Challenger* wrote and is quoted:

"FitzRoy visited St. Paul's Rocks on February 16; Ross on May 29; we on August 29; on all these occasions eggs and young birds were found. Hence breeding goes on all the year round."

Remarkable birds of the ocean are described clearly and simply by Dr. Murphy, who has gathered considerable information that is new to science. There is a description of the curious flightless rail (*Atlantisia rogersi*) of Inaccessible Isle of the Tristan da Cunha group: of the fairy tern (*Gygis alba*), most ethereal of sea birds and so fearless that it can be caught by hand as it hovers inquiringly though without hostility about the human intruder; of the Arctic tern (well-known in British waters) which for eight months of the year experiences no darkness, since after nesting in the Arctic, some at all events of these dainty fliers wander south and penetrate to the Antarctic seas, where they find again full summer and sunshine at midnight.

One of the most remarkable and beautiful birds described by Dr. Murphy is the snow petrel (*Pagodroma nivea*), which nests amid eternal snow and ice on the rocky frost-harried summits of south polar mountains. One colony of these strange birds was found nesting by the second Byrd Antarctic Expedition on a hill-top no less than eighty kilometres from the nearest sea (p. 673). There are arresting accounts of the boobies (*Sula*). The name is from the Spanish 'bobo', meaning a dunce. Boobies feed largely on flying fish, and these elusive fish the red-footed booby catches not only in the water but also in the air (p. 869).

Land is apparently as effective a barrier to the boobies of the South Atlantic as it is to the European gannet, which will fly many miles off its course rather than cross a narrow neck of land; thus we are told that the Panama Isthmus is never crossed by boobies, with one possible exception, although pelicans pass over it confidently.

The limited range of the flightless cormorant (*Nannopterum harrisi*) of the Galapagos is a remarkable contrast to the immense ocean flights taken by the greater shearwater (*Puffinus gravis*), whose only known nesting grounds are on the islands of the Tristan da Cunha group. Many thousands of this large shearwater are found each summer on

the Grand Banks of Newfoundland, having travelled from the South Atlantic into the North Atlantic via the water of the tropical seas, which they cross without delay as though heat and cloudless weather were distasteful to them. Dr. Murphy makes the interesting suggestion that with these shearwaters an annual breeding season may have been replaced by a longer reproductive rhythm. The Manx and the sooty shearwater also move between the north and south Atlantic zones.

The volumes are illustrated by many excellent photographs, and beautiful coloured reproductions of paintings done by Francis L. Jaques. The print is good, and there are a clear index and bibliography. The work will rank as a standard one on the subject. Dr. Murphy must have travelled almost as widely as the greater shearwaters in writing it; must have had many adventures and have suffered many hardships which his modesty forbids him to mention.

S. G.

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# Hindu Ideas of Self and Mind

**The Birth of Indian Psychology and its Development in Buddhism**
By Mrs. Rhys Davids. A rewritten and enlarged edition of "Buddhist Psychology". Pp. xii+444. (London: Luzac and Co., 1936.) 5s.

MRS. RHYS DAVIDS has long been recognised as one of the leading European authorities on Pali and Buddhist literature. In this work she endeavours to trace historically the rise and development of Hindu reflection on man and the human mind during a period of more than a thousand years. Embodying as it does the fruits of well-nigh half a century's labour, the volume cannot fail to be appreciated by all who are interested in Indian culture.

Her book, the author tells us (p. 355), is mainly concerned with beginnings. Accordingly, she devotes no small amount of space to the early Upanishads, and lays reiterated stress upon the distinction formulated in them between the man, or self, and the mind, conceived as an instrument of the self. To say that man is *ātman* or *ātmavant*, 'besouled', was equivalent to discerning in the self the potency of the divine nature, a 'being' that is in fact essentially a 'becoming', and as such surviving death. Moreover, as the 'subject' of mental experience, man was conceived as valuer and as user. He is, so it was inculcated, not body, sense or mind, but 'has' all these, uses them and values by them. In short, man's attributes were not thought of as going to produce a self as a product; contrariwise, in the self they had their basis and *raison d'être*. On the other hand, the mind (*manas*) was spoken of as a wherewithal to act upon the body. Man "seizes hold of" and animates the body "with the mind"; "with mind" he sees, hears, feels, etc.

In the Middle Upanishads we find, it is contended, partly through the wave of monasticism then commencing to make itself felt, the inculcation of a definite religious practice of introspection, which we do not yet find in the earlier collection. Sānkhyan terms and ideas came to be introduced in Brahmanic teaching. Inquiries into origins, preoccupation with causes, led to "a dethroning of the man from his identity with the Highest". "He has become a *pratipuruṣa*, an individual, opening the way to the 'plurality of selves' in Sānkhya" (p. 168). Along with this adopted exoteric analytic attitude there is to be noted the gradually increasing prevalence of the esoteric intuitive attitude, known as *yoga*. The control of mind, rather than its systematic development, was the leading motive in the later Upanishads of the middle period.

But Mrs. Rhys Davids offers strong grounds for holding that the teaching of Gotama and of the missioners (mainly Brahmins) who started the movement destined to grow into Buddhism was not thus impregnated with these new ideas. They appear, it is true, in the Nikāyas (the oldest complete canon of Buddhist teaching which has come down to us), but between the birth of Buddhism and its 'scriptures' there was an interval of some four hundred years, and during that interval it is practically certain considerable changes in general outlook must have occurred. Mrs. Rhys Davids makes the attempt to disentangle, out of the later records, fragments which may be taken to represent the earlier teaching. She looks upon 'original Buddhism' as an intensifying, so to speak, of what was most characteristic in the older Upanishads. It laid stress, she thinks, upon the notion of the self as that real being who valued things with mind, upon the man as having within, as it were, a Most or Highest, as being in potency the Divine, a potency which was realisable, not by gnosis and ritual, but in conduct. The mind was not a complex of so-called *khandha's*, but a

way in which the man or self valued things, a way in which he acted, which when desire or purpose were included in the thinking was described as *mano*.

Mrs. Rhys Davids then proceeds to examine in detail the views set forth in the Nikāyas regarding the self and the mind. Here, alongside many survivals of the original teaching, she discerns in the main an aberration therefrom. Ultimately we reach what she describes as "the Humian position in Buddhism". The change was, she conceives, chiefly due to the growth in north India of monasticism, and to the increasing preoccupation of Indian culture with the analysis of mind, known as *sānkhya*. The noteworthy feature in the Nikāyas is, we are told, the substitution, unexplained and undefended, of 'mind' for the 'man' or 'self'; by being resolved into five bundles of mental and bodily states (*kandha's*) the self as such was lost from view. Thus, in place of the positive 'becoming' and of the life 'beyond', as taught by the founder, latter-day Buddhists prescribe "the monk-goal of a waning-out (*nir-vana*) into an emptiness that is not—Man" (p. 431).

I add only a few words by way of criticism. The Upanishadic distinction between the self and mind may, I take it, be looked upon as a sort of primitive adumbration of the well-known Kantian distinction between the 'pure' and the 'empirical' ego. Modern psychologists are practically unanimous in rejecting that distinction. The assumption of a single entity somehow related to a manifold of mental states, and yet in essence independent of them, leads, indeed, to intolerable perplexities. But it is important to realise that, if the notion of a 'pure ego' calls to be abandoned, the notion of an 'empirical ego', or of a 'mind' as merely a complex of discrete states or processes, must go along with it, for they are in truth correlative notions. The unity of the experiencing self is, in other words, to be sought within its experiences, and not in a "something, we know not what", lying behind them or floating above them. In short, the processes of thinking, feeling, desiring and so on, evince themselves as transient modes or phases of an indivisible conscious subject; and I cannot see that this conception of the self or mind endangers any one of the interests which Mrs. Rhys Davids is anxious to safeguard.

G. DAWES HICKS.

# Popular Stratospherology

**Exploring the Stratosphere**

By Gerald Heard. Pp. vii + 98 + 9 plates. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1936.) 3*s*. 6*d*. net.

THE author of this small volume sets out to tell the man in the street all about the stratosphere in simple language—a worthy enough object. If the stratosphere becomes the most favoured region for long-distance aeroplane flights, it will, of course, have great practical importance to the general public. No one will deny that the stratosphere is of the utmost importance to meteorology, and that the electrical conditions prevailing at high altitudes are of the utmost importance to radio engineers, that the discovery that cosmic ray intensity increases with increasing height has great significance, and that generally speaking, the upper layers of the earth's atmosphere have great geophysical and astrophysical interest; nevertheless, Mr. Heard seems to us to show a lack of perspective in his first chapter, a general introduction which is packed with references to Magellan and Copernicus on one hand, and the stratosphere explorers (*stratonauts*) and theoretical investigators of the expanding universe on the other. ("A vast, embracing idea of the whole universe, the whole of reality, is to-day forming in the human mind. It is being hastened forward by stratosphere exploration.") Mr. Heard is one of the 'Bright New Things', a citizen of the 'Brave New World'; surely he is maligning our grandfathers in an uncalled-for manner when he suggests that they would almost have called "this unbelievable surprise" (the constancy of temperature with increasing height exhibited by the stratosphere) "a breach of a Law of Nature?"

A second chapter describes the actual balloon flights, of which some very interesting photographs are reproduced, and a third chapter describes "The Uses of the Stratosphere". The references to Dr. Goddard's experiments on rocket flights are disappointing and inadequate. The fourth and last chapter on "The Meaning of the Stratosphere" is written with an over-emphasis similar to that in the introduction. We may conclude by hoping that that section of the public which makes a serious effort to follow the remarkable movements in scientific thought which are taking place to-day will be able to draw a distinction between a good journalist writing about science and a good scientist trying to write journalism.

R. v. d. R. W.

**The Head-Hunters of Western Amazonas:**
the Life and Culture of the Jibaro Indians of Eastern Ecuador and Peru. By Prof. Rafael Karsten. (Societas Scientiarum Fennica: Commentationes Humanarum Litterarum, 7, 1.) Pp. xvi+598+34 plates. (Helsingfors: Societas Scientiarum Fennica, 1935.) n.p.

To the outside world, the Jibaros, the "Head-Hunters of the Western Amazonas", are best known as the source of the shrunken human heads, which are to be found in most ethnological collections. To the anthropologist, they are the most important members of a race, or group of Indians comprising a large number of tribes, inhabiting eastern Ecuador and Peru, who exemplify the forest culture of South America.

Dr. Karsten has spent an extended period of observation among the Jibaro on two occasions—in 1916–18 and 1928–29. Some results of his first visit were published by the Smithsonian Institution of Washington, D.C., in a memoir which dealt with the technique followed in the preparation of the shrunken heads and the cultural setting of the custom, which plays such an important part in war and religious belief among the members of the tribe. This account, the first, and indeed the only, authoritative report on the practice, is incorporated in the present volume with additions from subsequent observation. This, however, though perhaps the most important, and certainly the most spectacular, result of Dr. Karsten's investigations, is far from exhausting their interest. His fully detailed account of Jibaro culture and economy, and more especially of their feasts and dances, is of no little importance as a contribution to the study of the indigenous peoples of South America.

Dr. Karsten's investigations also covered the Canelos Indians, a group of mixed origin, now some two thousand in number, Christian in name, though preserving many of their pagan customs and beliefs. The Jibaro, on the other hand, though in contact with Europeans from the early days of the Spanish invasion, have sturdily resisted change in culture and language. The effect of outside influence, however, is now growing rapidly, a fact which gives this book an added value.

**Mathematics of Modern Engineering**
By Robert E. Doherty and Prof. Ernest G. Keller. Vol. 1. Pp. xxi+314. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 17*s*. 6*d*. net.

THE manifold problems of modern engineering are making great demands upon the applications of mathematics, and, as a consequence, many text-books dealing with the mathematical principles underlying such problems are making their appearance. The present volume—one of a series written in the interest of the advanced course in engineering of the General Electric Company—belongs to this class, and, as stated in the preface, is the result of "the joint participation of a mathematician who has worked in engineering, and of an engineer who has worked with mathematics". The book is therefore neither a text on mathematics nor on engineering; it aims rather at bridging the gulf in engineering between physics and mathematics.

The four chapters consist mainly of the mathematical formulation and solution of modern technical problems. After a short but thoroughly sound introductory chapter, the basic principles of mathematics, essential to the higher problems of engineering, are dealt with. Chapter ii is therefore concerned with differential equations, including graphical and numerical methods of solution; determinants, Fourier series, transcendental equations and dimensional analysis. Then follows a chapter on vector analysis, with special reference to the problems of mathematical physics, and finally, Heaviside's operational calculus is very ably dealt with in Chapter iv. The text is clearly printed and well illustrated, whilst problems and exercises are provided for the student.

Mention should also be made of the very interesting "Foreword for Instructors" which appears at the beginning. This reviews the increasing use which is being made of the applications of mathematics to practical problems, thus clothing the spectre of pure abstraction in a really useful garment.

**Electricity**
By Prof. W. L. Bragg. Pp. xi+286+34 plates. (London: G. Bell and Sons, Ltd., 1936.) 8*s*. 6*d*. net.

PROF. W. L. BRAGG's course of six lectures "adapted to a juvenile auditory" delivered at the Royal Institution at Christmas 1934 forms the basis of this book. The first three chapters deal with the behaviour of electric charges, electrical currents and magnets, and with such fundamental apparatus as cells, motors and dynamos. The other chapters deal with power stations and the transmission of electrical current, telegraphs, telephones and wireless. The demonstrations which are a feature of these lectures are, in the book, replaced by many excellent illustrations. Although the language used is simple and the style most pleasing, technical terms are freely used. Prof. Bragg holds the view that as in many cases no equivalent word can be found, it is simpler to explain each technical term as it arises and then to use it freely. There is no mathematics in the book. Units in which electrical quantities are measured are made more realistic by quoting figures from familiar examples.

It is a little regrettable that in such an authoritative account some of the careless abbreviations of units used by radio engineers should have been allowed to creep in, here and there. For example, on p. 261 a frequency of 1,000 kilocycles is mentioned and on p. 266 the statement "The frequency is about thirty million" is made. We are certain Prof. Bragg does not allow his students to talk of a "velocity of a hundred" or even of "a velocity of 100 ft.".

The book can be confidently recommended to those who desire a reliable account of electricity. Teachers and lecturers will also find it a valuable source of ideas for demonstrations and illustrations of obscure points.

**Landolt–Börnstein Physikalisch-chemische Tabellen**
Fünfte, umgearbeitete und vermehrte Auflage. Herausgegeben von Prof. Dr. W. A. Roth und Prof. Dr. K. Scheel. Ergänzungsband 3, Teil 1. Pp. viii + 734. 108 gold marks. Teil 2. Pp. viii + 735–1814. 162 gold marks. (Berlin: Julius Springer, 1935.)

THE third supplement of the familiar "Landolt–Börnstein–Roth" tables is divided into three parts since a very large amount of new matter has to be dealt with. The two volumes under review are Parts I and II; Part III, dealing with electrical, magnetic and thermal properties, is to appear during this year.

A glance at the contents reveals some of the directions in which active research has been prosecuted during the last few years. Part 1 contains large additions to the tables of dipole moments, and records a considerable amount of new work on the compressibilities of liquids and gases. A new table of the occurrence and relative abundance of isotopes is appropriately introduced, since nearly all the elements have now been analysed. Another new table which indicates the trend of modern work records the nuclear distances and vibration frequencies of simple molecules deduced from infra-red and Raman spectra.

Part 2 contains a large amount of new spectroscopic data, including a useful table of series and terms in line spectra. The Raman effect, which was first tabulated in the second supplement of these tables, occupies 280 pages in the third supplement. New tables in Part 2 include those dealing with hyperfine structure of spectral lines, with band spectra, and with the absorption of light in the infra-red.

There is no need to stress the immense value of the Landolt–Börnstein–Roth tables and their supplements. Physicists and physical chemists owe a debt of gratitude to the present editors, Profs. Roth and Scheel, which is increased by each new volume that is published. S. S.

**L'Ethnie française**
Par Prof. Dr. George Montandon. (Bibliothèque scientifique.) Pp. 240 + 48 plates. (Paris: Payot et Cie., 1935.) 30 francs.

PROF. MONTANDON opens his study of the racial characters of the population of France dramatically with the statement that there is no French race—a statement presumably *pour épater le bourgeois*, as it is one with which the vast majority of his colleagues in anthropology would have no quarrel, and, indeed, would scarcely regard as novel.

After an exposition of the hologenetic point of view in the origin and distribution of races on the lines of his previous works, of which an excellent summary appears in *Scientia* for September, 1935, Prof. Montandon describes the distribution of racial characters in the French population so far as it has now been observed, and bases thereon a classification of racial types. His classification, as he points out, differs in certain essentials from that of Deniker, which distinguishes six racial types, three of them belonging or closely related to the Alpine group, and three to the Mediterranean. Prof. Montandon distinguishes four main types with sub-types, and three more or less localised groups, the most important innovation on Deniker's classification being the recognition of a Nordic element with its sub-types. The author maintains that it is possible also to distinguish a Basque type, this differentiation being based mainly on the form of the nose. This type was overlooked by Deniker through his reliance on a too limited number of characters as his basis of classification.

Dr. Montandon's study is a welcome reopening of a question which requires reconsideration in the light of modern methods of inquiry and recent theory.

**An Introduction to Astronomy**
By Prof. Robert H. Baker. Pp. vi + 312. (London: Macmillan and Co., Ltd., 1935.) 12*s*. 6*d*. net.

THE author of this book is professor of astronomy in the University of Illinois. In 1930 he wrote "Astronomy", containing five hundred pages and published by the Van Nostrand Company, New York. The new "Introduction to Astronomy" is a shorter, simpler, but more attractive book, which presents the more essential elements of astronomy in a clear way by means of careful writing, skilful diagrams and good photographs. The charm of the book is somewhat disturbed by examination or revision questions at the end of each chapter. For example, on page 282 is a section headed "Interstellar space is not empty"; and seven pages later comes the question "What are the reasons for believing that interstellar space is not empty?" There are, however, questions requiring some imagination, such as (p. 305)—"Describe the appearance of the heavens as viewed from somewhere in the arms of Andromeda Nebula". The request to "show that Kepler's laws completely disproved the Ptolemaic system" (p. 160) raises some interesting philosophical questions which recall Poincaré.

This book is entirely devoid of any mathematical formulæ or calculations. The publishers are, however, justified in recommending students to "retain it for your reference library. You will use it many times in the future". Students should not burn their books behind them. No doubt as the evil visage of examinations recedes into the background, there will be more pleasure in life, in astronomy and in the book under review.

**An Introduction to Cultural Anthropology**
By Prof. Robert H. Lowie. Pp. xiii + 365. (London: George G. Harrap and Co., Ltd., n.d.) 10*s*. 6*d*. net.

STUDENTS of anthropology will welcome an English edition of Dr. Lowie's valuable review of the field covered by the study of cultural anthropology, which appeared in the United States in 1934. In collecting illustrative material, good use has been made of the results which have accrued from the intensive ethnographical study of the tribes of California, now in progress for some years, but comprehensively not so widely known by British students as it deserves.

# Sexual Periodicity and the Causes which Determine It*

By Dr. F. H. A. Marshall, C.B.E., F.R.S.

SEXUAL periodicity, like all vital phenomena, is conditioned by the environment. Under the term 'environment' are included food, light, temperature, the humidity of the atmosphere and in aquatic species of animals, the hydrogen ion concentration of the medium and all the other chemical and physical conditions of the surroundings.

In all animals with reproductive organs, there is a tendency to an alternation of periods of activity and periods of rest associated with the development of the gonads and their exhaustion after they have discharged their products, as seen especially in those animals which spawn in bulk. In the lower animals in which there is no nervous system, the environment must be supposed to act directly upon the organism, and so influence the rhythm of reproduction. But in the higher animals sexual periodicity is determined and regulated by special factors which, though generally similar, show great variation in passing from group to group and from species to species and even from breed to breed.

These factors are: (1) endocrine factors associated especially with the gonads (and their successive functional phases) and with the anterior pituitary; and (2) exteroceptive factors which through the intermediation of the nervous system act upon and modify the endocrine factors. In the male mammal the testes produce a hormone, testosterone, which is responsible for all the changes which take place in the accessory sexual organs and in the secondary male characters in association with the sexual season; the testis is acted upon by a hormone formed by the anterior pituitary, and the latter organ is influenced by exteroceptive and possibly also other stimuli coming from the outside environment. In the majority of animals, light is probably the most important factor, but there are others.

In this way, the sexual rhythm is normally brought into relation with the seasonal changes, and the activity of the anterior pituitary and that of the testes rise and fall almost simultaneously. The accessory organs may be brought into a state of activity outside the normal breeding season by the injection of testicular hormone, by the injection of an anterior pituitary hormone, and, in many species also, by light irradiation.

In the female mammal, the processes are similar but the matter is complicated by the occurrence of pregnancy and, in polyœstrous species, by the recurrence of heat periods at short intervals within the sexual season. There are two main phases of ovarian activity: (1) the follicular or œstrous phase which is induced by the ovarian hormone, œstradiol; and (2) the luteal phase of pregnancy, pseudo-pregnancy and the short diœstrous interval (in polyœstrous species), which are generally controlled by the hormone progesterone formed by the corpus luteum. The œstrous-producing substances found in the urine and elsewhere during pregnancy and the œstrin in the urine of the male are to be regarded as metabolic products of no physiological significance in relation to the control of the cycle, and it is to be pointed out, first, that many other substances having œstrogenic properties when injected into animals experimentally, have been extracted from organisms both animal and vegetable or even have been prepared synthetically, and secondly, that the œstrins which are excreted during pregnancy occur in the urine mostly in a combined and inactive form.

The endocrine activities of the ovaries are themselves controlled by the anterior pituitary, but whether there is one or more than one gonad-stimulating hormone formed by the anterior pituitary is still doubtful. It appears certain, however, that the secretory activity of the anterior pituitary must vary quantitatively if not qualitatively in different phases of the œstrous cycle. In species like the rabbit and the ferret which normally only ovulate after the orgasm, the switch over from the œstrous to the luteal phase of the cycle is effected by the anterior pituitary, and can be induced experimentally by the injection of a pituitary extract or by electrical stimulation of the central nervous system, thereby producing a general stimulus comparable to the orgasm. Moreover, in the rat, which ovulates spontaneously, a comparable condition of pseudo-pregnancy can be induced by experimental stimulation. The duration of the corpus luteum therefore may depend upon a hormonic stimulus from the anterior pituitary.

Further, the condition of pregnancy apparently reacts upon the pituitary and so controls the duration of the corpus luteum of pregnancy, and in rats stimulation of the nipple by sucking or artificially by other means and without the secretion of milk, will react on the pituitary and maintain the corpus luteum of lactation. In the absence of any exteroceptive stimuli which alter the phases of the cycle, the alternation between the œstrous phase and the diœstrous phase may

* Substance of the Croonian Lecture delivered before the Royal Society on June 18.

be controlled by the ovary and anterior pituitary acting and reacting on one another, the pituitary initiating the œstrogenic activity of the ovary, which then has a temporary inhibiting effect on the stimulating capacity of the pituitary until such time as the production of œstrin is reduced, when the pituitary responds by an increased production of ovary-stimulating hormone. There is certain experimental evidence for this view.

The phase of lactation, also, is believed to be controlled by the anterior pituitary, and a substance has been extracted from it which stimulates milk secretion. The same substance, which is called prolactin, will also stimulate the crop gland in the pigeon and induce incubation. This is in conformity with the view that the reproductive hormones were metabolic by-products before they acquired hormonic activities, and that other organs and tissues in the body gradually learnt, so to speak, to respond to their presence in the progress of evolution and so promote functional correlation between different parts of the body.

In the female mammal, like the male, light and ultra-violet irradiation may induce œstrus outside the breeding season, the stimulus probably acting upon the pituitary. The same is true for many species of birds, but both in mammals and birds there is much species variation, each kind of animal requiring its own appropriate stimulus of light or other factors. The successive phases of the cycle in birds are likewise under the influence of anterior pituitary gonad-stimulating mechanisms, but they are very liable to be interfered with by exteroceptive stimuli.

In most birds ovulation depends upon coition, or at any rate on sexual display, and there is evidence that courtship phenomena play an important part in effecting the necessary synchronisation of the anterior pituitary processes in the male and female. Such a theory as to the biological value of sexual display and adornment may take the place of the Darwinian theory of sexual selection, and without encountering the difficulties in the way of that theory, one of the most formidable of which is the fact that birds of many species pair before they display and often pair for life. The biological disadvantages of an ineffective synchronisation between the various generative functions is illustrated from the domestic animals, in which temporary sterility is common.

# The Universities of Great Britain: Education for a Living and for Life

THE universities of Great Britain have shown remarkable buoyancy in the rough weather produced by the world-wide financial and economic stresses of 1930 and following years. So much is clear from the University Grants Committee's recently published report* for the period 1929–30 to 1934–35. A perusal of the Committee's previous reports makes it equally clear that this steadiness in the face of adversity is attributable in no small measure to the Committee's own foresight, watchfulness, sympathetic understanding and wise counsel. Appointed by the Chancellor of the Exchequer in 1919 to advise the Government as to the needs of university education in Great Britain, this Standing Committee has used with such tact and good sense its unrivalled opportunities of insight into university affairs as to enable it to play, with acceptance, the far more exacting and delicate role of adviser to the universities. "There has been," to quote the words of Dr. Ernest Barker in *The Times* of April 18, "fostering care without control; there has been guidance and suggestion without command. The British universities draw one third of their annual revenue from the Parliamentary grants distributed by the Committee; but it is safe to say that not one of them has felt a feather-weight of domination from the Committee."

The past six years saw notable increases in university student enrolments, and great improvements in accommodation for laboratories, libraries, medical schools, research institutes, halls of residence and students' unions. A statistical table elsewhere in this article shows an increase in student numbers of eleven per cent as compared with an increase in the preceding quinquennium of three per cent; but the rate of increase is now slackening. Accumulated deficits were brought down from £200,000 to £72,000; capital benefactions were at the rate of a million pounds a year; additions to general endowment funds amounted to £2,280,000; but endowment incomes dropped owing to reduction in interest rates.

After reviewing salient developments since 1929, the Committee proceeds to a consideration of

* University Grants Committee. Report for the period 1929–30 to 1934–35, including Returns from Universities and University Colleges in receipt of Treasury Grant for Academic Year 1934–35. (London: H.M. Stationery Office, 1936.) 4s. net. The Report is signed by Sir Walter H. Moberly (chairman), Sir Arthur W. Hill, Sir Geo. Macdonald, Sir Humphry Rolleston, Prof. G. I. Taylor, Prof. W. P. Wynne, Miss Margery Fry, Sir Frederic G. Kenyon, Sir Stanley Leathes (the membership of the last three dating back to the first appointment of the Committee in 1919) and John Beresford, secretary.

present needs and problems, taking as a central theme the *quality* of the education the universities are able to offer to their students. If this fundamental question has for a whole generation been relegated to the background, this is attributable to the bewildering rapidity with which changes have followed one another in the universities since the vast increase in secondary schools inaugurated in 1902. Conditions have been such that the authorities "were of necessity occupied breathlessly in a day-to-day endeavour to meet each new need as it arose". That, at any rate, is the view of the Committee, which holds, however, that quantitative growth will be less rapid in the immediate future, and that it is now possible for the universities to devote their main energies to improving the quality of the education which they offer, "and nearly everywhere we see signs that they are doing so".

In accordance with this view, the present report is chiefly concerned with the human undergraduate, his needs and problems, with halls of residence and the social life of students, with such increases of staff as would make possible more personal contact between staff and student, with the provision of adequate facilities for physical training for all students, with the prospects of finding employment on leaving the university. Nor does the Committee shrink from giving an answer to the question underlying all discussion of the quality of university education: What is its purpose? The answer is given in the form of a question as to the estate of the university graduate on completion of a professional training. (The employment of the masculine pronoun and "man" is, needless to say, not in a sex-exclusive sense.) "Has he also received that stimulation and enrichment of the whole mind which will enable him to lead a fuller and more interesting human life and to play more adequately his part as member or leader of the community? In other words, does a university training notably enhance a man's equipment, not only as a skilled worker but as a member of society and a human being?"

This accords with the traditional English conception of the purpose of a university education. Although evolved at Oxford and Cambridge, and although its evolution was conditioned by their college systems, this conception has profoundly influenced their younger sisters. It differs widely, of course, from prevalent ideals in some foreign countries. The character and extent of its influence are discussed in a supplement to *Time and Tide* of February 23 and March 2, 1935, entitled "English Universities, Old and Young", by a member of the Committee (Miss Margery Fry).

It is in the mainly non-residential universities that nearly four-fifths of the student population of Great Britain are to be found, and the report deals at some length with the problem how far it is practicable for the authorities to amplify the existing provision for the social life of the undergraduate so as to offer more opportunities for friendship and fellowship between students. It passes on to the relation between student and teacher, taking as text Sir Walter Raleigh's "a university consists not of pupils and teachers but of junior and senior students", recapitulates the arguments against compulsory lectures and offers some suggestions aimed at providing facilities for "the vivifying contact of minds in the tutorial hour".

Closely interlocking with the problem of means whereby an improvement of the quality of university education may be brought about is the question of the outlook for students who have received such an education and have to enter employment of some kind afterwards. The discussion of this question is prefaced by a review of the growth of the student population since the beginning of the century. It seems that the proportion of students to the general population has increased from 1 in 1827 in 1900–1 to 1 in 885. There are wide divergencies between England, Wales and Scotland, thus: in England the number of inhabitants per student decreased from 2,204 to 1,013, in Wales from 1,606 to 741, in Scotland from 868 to 473. Corresponding figures relating to the year 1934 for some other countries (Italy, 808; Germany, 604; Holland, 579; Sweden, 543; France, 480; Switzerland, 387; United States, 275) are quoted from a publication by the International Student Service entitled "Planless Education, an International Study of the Unemployment in the Learned Professions".

Statistics concerning the number of students in the universities of Great Britain are given below.

FULL-TIME STUDENTS

| | | 1928–29 | 1934–35 |
|---|---|---|---|
| Oxford and Cambridge | Men | 8,900 | 9,281 |
| | Women | 1,312 | 1,383 |
| | Total | 10,212 | 10,664 |
| London | Men | 6,003 | 7,875 |
| | Women | 3,138 | 3,381 |
| | Total | 9,141 | 11,256 |
| English provincial univs. (eight) and three independent colls. | Men | 7,526 | 10,003 |
| | Women | 3,819 | 3,565 |
| | Total | 11,345 | 13,568 |
| All England | Men | 22,429 | 27,159 |
| | Women | 8,269 | 8,329 |
| | Total | 30,698 | 35,488 |
| Wales | Men | 1,660 | 2,562 |
| | Women | 1,004 | 938 |
| | Total | 2,664 | 3,500 |
| Scotland | Men | 7,321 | 7,478 |
| | Women | 3,626 | 2,768 |
| | Total | 10,947 | 10,246 |
| Great Britain | Men | 31,410 | 37,199 |
| | Women | 12,899 | 12,085 |
| | Total | 44,309 | 49,284 |

Although it is certain that unemployment among university graduates in Great Britain has not hitherto been nearly so serious as in some foreign

countries, the Committee endeavoured in the course of its visits to universities to ascertain what grounds there are for anxiety on this score. Its inquiries led to the conclusions that in England the output of graduates is not at present excessive in relation to the avenues of employment open to them; that in Wales (where the proportion of students to the general population increased from 1 in 1,005 to 1 in 741 in the years 1925–35) the waiting lists of graduates seeking employment as school teachers are far too long, and there is a certain amount of unemployment among other classes of graduates; and that in Scotland a temporary over-production of school teachers is in course of adjustment through a substantial diminution in the number of entrants to the universities, especially Edinburgh and Glasgow. In both Wales and Scotland the situation calls for vigilance on the part of the authorities.

In this connexion, the Committee points out that even where there is no actual unemployment, the situation cannot be regarded as satisfactory if much of the employment obtained is not suitable, involving a sense of frustration with consequent loss of efficiency. Accordingly it urges upon university authorities the pressing importance at the present time of perfecting means and methods of establishing effective contact between students and prospective employers.

In one field, that of Local Government service, which seems peculiarly fitted for and likely to derive very great benefit from the employment of university-trained recruits, the defenders of the present method of recruiting have hitherto successfully withstood not only the efforts of the Committee and the universities but also the representations on qualifications, recruiting, training and promotion of Local Government officers of the Royal Commission on Local Government and the Hadow Committee. The present report urges that local authorities, contributing as they do some £870,000 a year to the universities, should, by extending to university graduates all reasonable opportunity for obtaining work, "endeavour to reap a fair share of the harvest they have sown". For the rest, the Committee notes that a larger and larger number of industrial and commercial appointments are being thrown open to university graduates. "Industrial research and administration, the library service, journalism, the almoner service of hospitals and the like may, it is to be hoped, absorb increasing numbers."

It is well that the university authorities should bear continually in mind the practical necessities imposed by the operation of the laws of supply and demand in relation to recruitment for the various vocations, and the student's ambition to be qualified for earning a living; yet must they guard against excessive preoccupation with vocational training. The Committee commends to the serious consideration of each of the universities severally the problem, "Has the time already arrived, or is it on the point of arriving, or is it still remote, when every addition to our numbers will tend to weaken the quality of the instruction and still more the value of the training for life which we seek to give?" The Committee emphasises the great importance, especially at the present time, of the impress received and the capacities developed by the student in the course of life as an undergraduate: "Every year 15,000 young men and women enter the universities. From their ranks, representing every section of society*, are drawn the great majority of those who will become leaders in the national life. To ensure conditions of training which will enable them to go out into the world with minds richly informed, unsleeping in the exercise of a critical intelligence, and imaginatively alive to the human issues underlying the decisions they may be called on to make, is perhaps the highest form of service." Will the universities make haste to seize this opportunity of service, of leavening the whole community? We live in an age, as the Committee points out, when confidence in the power of human reason seems to be roughly shaken, when appeals to mass hysteria seem often more successful than appeals to reason.

This theme of training for life is further developed in connexion with the exceptional responsibility resting on the British universities at the present time, owing to the suppression in the universities of several European countries of all independent thought and critical discussion of the principles of government or of the meaning of life, while in other countries there is apparent both confusion of belief in regard to fundamental issues and apathy arising from failure to think seriously. "Certainly," says the Report, "it is no part of the duty of the university to inculcate any particular philosophy of life. But it is its duty to assist its students to formulate their own philosophies of life, so that they may not go out into the world maimed and useless. It should stimulate and train them, not of course necessarily to think alike, but at least to think, and to think strenuously about the great issues of right and wrong, of liberty and government, on which, both for the individual and for the community, a balanced judgment is essential to a rational life". The gap between these lofty aims and immediately practicable achievement is, no doubt, wide; the report essays to point the way towards bridging it.

* Fifty per cent of the students in the provincial universities began their education in public elementary schools, and more than 43 per cent of Oxford and Cambridge students are assisted from other than personal and private sources.

# The John Innes Horticultural Institution

THE John Innes Horticultural Institution is a private foundation for research on plants. It was founded in 1910 under the will of the late John Innes, a resident of Merton, who died in 1904. The occasion of the present article is the completion of the first twenty-five years of work, which has been marked by the issue of a commemorative pamphlet by the Institution.

John Innes envisaged, in the first place, only a small training school for gardeners, but delay, due to litigation, in the drawing up of the scheme, and an unforeseen increase in the value of the estate, made it possible in 1909 for the trustees to embark upon a larger plan. The scheme as drawn up gave as the objects of the Institution "The promotion of horticultural instruction, experiment and research"; it was to "carry out investigations and research, whether of a practical or scientific nature, into any matters having reference to the growth of trees and plants generally". The Institution was established at Merton, some ten miles from central London. The property consists of about 15 acres of land close to John Innes's residence, the Manor House (now occupied by the Director). In the main garden are the biological and chemical laboratories, offices and library of the Institution, together with thirteen greenhouses and appropriate outbuildings for the garden establishment. The Institution also possesses ten dwelling-houses. The present staff consists of the director, Sir Daniel Hall, with sixteen scientific and seven administrative and technical workers, and forty-five gardeners and manual workers.

The intention of the founder with regard to the training of gardeners is met by the annual appointment, for a period of two years, of six student gardeners, who are paid a maintenance grant. These students are men of about twenty years of age, who must have had four years' gardening experience. They are accepted from all parts of the country. Lectures are arranged for them during the winter season, and they get a varied training in practical work. For the benefit of these students, a representative collection of indoor and outdoor plants is kept up. Since the foundation of the Institution, ninety gardeners have passed through this training. Of the former gardeners, sixteen are now in posts abroad, six are horticultural instructors in the county services and a large number are on the staffs of public parks and botanic gardens.

The trustees in 1909 appointed the late William Bateson to be the first director. Bateson having initiated the study of genetics in Great Britain, naturally turned his attention chiefly to plant breeding, though provision was made for cognate branches of study. The plants investigated in the early days included *Primula sinensis*, *P. kewensis*, *Pisum sativum*, *Lathyrus odoratus*, *Begonia*, *Pelargonium*, *Beta*, *Linum*, various fruit trees and a large range of forms showing variegation and somatic segregation. Four years after the work had begun, it was dislocated by the outbreak of the Great War, and came almost to a standstill in 1917.

After the War, when the threads were gathered together again, Bateson became converted to the importance of chromosome studies in connexion with genetics, and in 1922 he appointed W. C. F. Newton to the staff. Newton introduced a technique largely his own, and was able to solve problems of chromosome behaviour which had evaded previous workers on plant material. He found an apt pupil and ally in C. D. Darlington, who took charge of the cytological work on Newton's early death in 1927.

On Bateson's death in 1926, the directorship passed to Sir Daniel Hall, who maintained the general trend of the work, appointing J. B. S. Haldane to take charge of the genetics, and installing a biochemist. Research was continued on several experiments of long standing, including *Pisum sativum*, Mendel's classical subject, and *Primula sinensis*, which has a continuous genetic history since 1903, when it was first used as an experimental plant by Gregory and Bateson at Cambridge. Other genetical investigations were begun or extended; by J. Philp (now at Cairo) on Newton's poppy material; by C. J. Huskins (now at Montreal) on wheat and oats; by F. W. Sansome (now at Manchester) on *Lycopersicum*; by W. J. C. Lawrence (now curator) on *Dahlia*; with many other smaller problems. In a different branch of work, D. M. Cayley and A. W. McKenny Hughes discovered the virus origin of 'breaking' in tulips.

A considerable share of the experimental ground is taken up by the fruit department, the slow-maturing material of which needs a long period of cultivation. M. B. Crane has been in charge of this work since 1919. The experiments are planned from a theoretical point of view, but have several very practical bearings, particularly as regards cross-pollination and the improved varieties

which arise in the course of experiment. Government grants have recently allowed the Institution to engage two assistant pomologists to train under Crane's direction. The Institution is co-operating with various outside bodies, which are growing the new varieties of fruit trees and bushes to test their commercial value on a larger scale than could be done at Merton. A blackberry under the varietal name "John Innes" was recently put on the market through the medium of a trade firm.

The close co-ordination of genetics and cytology begun in 1922 has been continued and extended wherever possible, and is an essential feature of the Institution's method. In addition, there has grown up in the last ten years a school of pure cytology, developing its own special technique for studying heredity and variation and using as experimental material whatever organisms, plant or animal, lend themselves to the problems under investigation. In the last few years, with the advent of R. Scott-Moncrieff, a co-ordination of genetics with the biochemistry of flower-colour has begun, while the cytologists have been using X-ray technique in the solution of their special problems, apart from the use of such methods to induce mutations for genetic study. Sansome has collaborated with the Lister Institute on problems of comparative vitamin C content in diploid and tetraploid strains of *Solanum Lycopersicum*.

The Institution has always welcomed visitors from home or abroad who were desirous of taking part in its work or carrying on suitable investigations of their own. There is room for about ten visitors in the various laboratories. Since 1910, some 176 men and women from all over the world have taken part in the scientific work of the Institution, and some six hundred scientific papers and communications have been published. The Institution was recognised in 1931 as a School of the University of London for higher degrees, though it does not accept students specifically to train for their Ph.D. It undertakes no formal teaching, but every two years or so a short course is organised in the summer (July 13–25 this year). On these occasions about forty lectures are given on the special studies of the Institution, and the course is open without fee to members of university and research station staffs and post-graduate students. The summer course is held in the hope of stimulating interest in genetics and cytology, which are as yet little encouraged in the universities, in the hope that these actively growing branches of science may come to take their place in the academic syllabus, and enable teaching to keep pace with research.

# The Total Solar Eclipse of June 19

## Preliminary Reports

At the time of going to press, the available information indicates that the observations of the total solar eclipse of June 19 were unusually satisfactory. By the kindness of Prof. B. P. Gerasimovič we have received news to the effect that at five out of the six stations from which he had received reports, the programmes were successfully carried out. The other—at Kustanay, where the Astronomical Observatory of Moscow, the National Geographic Society of Washington, and the Paris Observatory, were represented—unfortunately experienced rain. "In total, extremely successful eclipse" is Prof. Gerasimovič's summing-up.

The five successful stations were as follows:

(1) At Beloretchenskaya, where the Astronomical Observatory of Kharkov, the French Astronomical Society and the Leyden Astronomical Observatory were working.

(2) At Ak Boulak, near Orenburg. Here the Astronomical Observatory of Poulkovo and the Harvard College Observatory had planned extensive spectroscopic observations of the chromosphere and corona in the ultra-violet and infra-red, and the programmes included the use of both fixed- and moving-plate cameras.

(3) At Sara, also near Orenburg, where a second expedition from Poulkovo and parties from the Astrophysical Observatory at Arcetri and the Astronomical Society of Czechoslovakia had prepared for further spectroscopic observations and direct photography of the corona.

(4) At Omsk, where a third group of observers from Poulkovo and expeditions from the observatories of Kyoto and Poland, as well as the British party under Prof. J. A. Carroll, were stationed. The programmes here included spectrophotometry and the study of polarisation phenomena, interferometric observations of chromospheric lines and internal motions in the corona, in addition to further direct photography of the corona and an attempt to obtain more complete records of the infra-red coronal spectrum.

(5) At Botchkarevo, where a party from the local observatory was engaged.

Prof. Stratton, who was in charge of the second British expedition, to Kamishari, in Japan, has cabled to us as follows: "Royds successful with Fraunhofer spectrum partial phase right up to totality. Flash spectrum observed through gathering clouds. Corona entirely spoilt by thick cloud". It appears, therefore, that the sun was obscured during the time of total eclipse by clouds which formed as a result of the fall of temperature, and dispersed shortly afterwards. It is clear, however, that observations during totality were not altogether prevented, and it seems that Dr. Royds, from the Kodaikanal Observatory, India, who joined this expedition for the purpose of observing the Fraunhofer spectrum of the sun at the limb just outside totality, has been successful, as the sky was apparently clear during the phases of the eclipse in which he was interested. Prof. Stratton's programme was an extensive one, involving much preliminary labour, and sympathy will be generally extended to him if his efforts have been fruitless. Elsewhere in the region of totality in Japan, the sky appears to have been cloudless, and Japanese and Polish astronomers are said to have made successful observations. Dr. R. L. Waterfield, stationed in the Island of Chios, is reported to have had excellent conditions for observing. The sun was low in the sky, but the atmosphere was exceptionally transparent.

It is clear that if the work attempted at the many fortunate stations has been successfully done, some very valuable observations have been made. Good weather at every station was, of course, too much to expect, and while the failures must be regretted, there are good grounds for hoping that most, if not all, the results aimed at will have been achieved elsewhere. Prof. Carroll's success is particularly gratifying, coming, as it does, after four disappointments, and everyone will wish him a successful issue to his first opportunity of eclipse observation. There have been very few occasions on which the earliest post-eclipse prospects have been so favourable, and the astronomers of all the countries concerned are to be congratulated, and those of the U.S.S.R. and Japan warmly thanked for the ungrudging help they have given to their many visitors.

# Obituary

## Sir George Hadcock, K.B.E., F.R.S.

THE death on June 4 at the age of seventy-five years of Sir George Hadcock has deprived artillery science of a research worker of great ability and acknowledged eminence.

The problems involved in the design and construction of modern ordnance call for the aid of the mathematician and physicist, no less than for the skill of the engineer and metallurgist, and Sir George possessed the experience and knowledge necessary for the investigation of such problems in their widest aspects. His early training as an engineer, coupled with his mathematical ability, enabled him to carry on the work begun by Sir Andrew Noble, whose fundamental researches may, very fairly, be said to have originated the study of artillery in Great Britain as a science. Thus, Noble had determined, by ingenious experiment, the gas pressures set up in a gun on firing, and had given curves relating the pressure to the position of the projectile in its motion down the bore. Such pressure-space curves, as they are called, are of fundamental importance to the gun designer, and Hadcock early set himself the task of developing a rational method which would give the required information, by calculation, from the data of the problem. He began with empirical formulæ but later developed analytical methods which enabled general internal ballistic calculations to be made.

Sir George Hadcock, indeed, had an abiding interest in internal ballistics, and made important contributions to its mathematical theory in papers published by the Royal Society and the Royal Artillery Institution. His close association with a mathematician of the calibre of Sir George Greenhill was, no doubt, an incentive to him to carry out mathematical work, and he amplified some of Greenhill's investigations, notably those on the stability of spinning projectiles.

Sir George was always keen to follow up modern developments, and, being both a mathematician and a practical engineer, was able to combine theory and practice with happy results. This trait may be illustrated by his interest in the method of gun construction known as 'autofrettage', a method which utilises a single tube in place of the two or three common in the usual built-up gun; the hoop strength of the autofrettaged tube being increased by successive applications of internal pressure sufficient to overstrain its innermost layers. The effect is to make the outer layers behave as the shrunk-on outer tubes, in the built-up gun. The method had been developed abroad before the Great War, and certain French writers, notably Jacob and Malaval, had investigated the theory of plastic strain and its application to monobloc gun construction, calculation of the stress-strain system in an overstrained tube being possible, making certain simplifying assumptions.

The subject was investigated theoretically by Sir George, and he carried out, soon after the War, extensive experiments with the object of discriminating

between the rival theories in the field. These trials called for considerable ingenuity in the engineering technique employed, since very high pressures had to be maintained for a considerable time.

In other connexions, notably the design of apparatus to withstand high and rapidly applied pressures, Hadcock was an acknowledged expert, and his aid in this direction was sought not only by those engaged in research on artillery problems, but also by workers in purely scientific fields. He kept up to the last his interest in all matters connected with the science of artillery, and in his later years was glad to foster the work of younger contributors, always being generous in encouragement and advice.

C. A. C.

### Prof. M. Baratta

MARIO BARATTA, the historian of Italian earthquakes and professor of geography in the University of Pavia, died on September 5, 1935, and his death leaves a gap, not only among the seismologists of his own country, but also among those of the world. Baratta was born on August 13, 1868. At the close of his university career, he showed so marked a preference for the study of earthquakes that he was transferred to the geodynamic observatory of Ischia, then under the direction of the late Prof. G. Grablovitz. At the beginning of 1892, he was appointed an assistant in the Central Office of Meteorology and Geodynamics, where he served in the latter department until June 1896. It was here that he began his studies of Italian earthquakes that led up to his great work "I Terremoti d'Italia", published in 1901. A closely printed volume of 950 pages, it is certainly the most valuable history that we possess of the earthquakes of any country. Confining himself to earthquakes that were destructive or that verged on destructive power, he describes no fewer than 1364 such earthquakes between the beginning of the Christian era and towards the end of 1898. In the second part of the volume, he studies in detail the distribution of Italian earthquakes in 22 well-marked districts. A worthy successor to this history was his detailed report on the Messina earthquake of December 28, 1908, published in 1910.

# News and Views

### King's Birthday Honours

THE following names of men of science and others associated with scientific work appear in the list of honours conferred by the King on the occasion of His Majesty's birthday: *Viscount:* The Right Hon. Lord Dawson of Penn; *Barons:* Sir Herbert Austin, chairman of the Austin Motor Company, Ltd., for public services; Sir Malcolm Hailey, lately Governor of the United Provinces of Agra and Oudh; *K.C.B.:* Dr. A. S. MacNalty, chief medical officer, Ministry of Health and Board of Education; *Knights:* Prof. F. Anderson, emeritus professor of philosophy in the University of Sydney; Dr. H. N. Gresley, chief mechanical engineer, London and North Eastern Railway; Prof. C. S. Hicks, professor of human physiology and pharmacology in the University of Adelaide; Dr. G. T. Morgan, director of chemical research, Department of Scientific and Industrial Research; Dr. J. Morton, for services to the dye and colour industries; Captain H. A. S. Newton, member of Council and censor-in-chief, Royal Australasian College of Surgeons; Dr. E. O. Teale, mining consultant to the Government of Tanganyika Territory; Mr. F. J. West, for public services to Manchester.

*C.B.:* Dr. H. I. Bell, keeper of the Department of Manuscripts, British Museum; Dr. G. Rotter, director, Explosives Research Branch, Research Department, Royal Arsenal, Woolwich; *C.M.G.:* Dr. H. H. Scott, director of the Bureau of Hygiene and Tropical Diseases, London; *C.I.E.:* Prof. J. J. Harper-Nelson, formerly principal and professor of medicine, King Edward Medical College, Lahore; Dr. F. J. F. Shaw, director, Imperial Institute of Agricultural Research and Imperial economic botanist, India; *C.B.E.:* Mr. R. W. Thornton, agricultural adviser to the High Commissioner for Basutoland, the Bechuanaland Protectorate and Swaziland, and director of agriculture, Basutoland; Mr. G. S. Whitham, assistant director of ordnance factories, War Office; *I.S.O.:* Mr. E. T. McPhee, Commonwealth statistician, Australia; Mr. M. P. Payne, chief constructor, Royal Corps of Naval Constructors, superintendent of Admiralty Experiment Works, Haslar; Mr. R. F. Taylor, statistical officer, Mines Department; *O.B.E.:* Mr. G. F. Clay, Colonial Agricultural Service, deputy director of agriculture, Uganda Protectorate; Mr. E. H. E. Havelock, secretary, Development Commission and administrative secretary, Agricultural Research Council; Mr. J. R. Hill, resident secretary in Scotland of the Pharmaceutical Society of Great Britain; Mr. J. Paley Yorke, principal of the London County Council School of Engineering and Navigation, Poplar; *M.B.E.:* Mr. M. R. Ry. Achariyar, executive engineer, Electricity Department, Madras; Mr. G. E. Bailey, accountant, National Physical Laboratory; Mr. F. H. Butcher, Madras Agricultural Service, lately curator, Government Gardens, Ootacamund, The Nilgiris, Madras; Mr. H. R. Edmunds, superintendent of agriculture, Kalimpong, Bengal; Mr. P. G. Lloyd, chemist and manager, Borough Sewage Works Department, Kingston-upon-Thames; Mr. M. R. Nayudu, acting chemical examiner, Madras; Mr. F. H. Newington, assistant analyst, Admiralty Chemist's Department, Portsmouth; Mr. E. W. Swanton, curator of the Haslemere Educational Museum, Surrey.

### Royal Society Elections

AT the meeting of the Royal Society on June 25 it is proposed to elect Sir Thomas Middleton as a fellow under Statute 12, which provides for the election of persons who "either have rendered conspicuous service in the cause of science, or are such that their election would be of signal benefit to the Society". The following foreign members will also be elected: Prof. Sigmund Freud, Vienna; Prof. Ludwig Jost, Heidelberg; Dr. F. A. Vening Meinesz, Utrecht; and Prof. Hermann Weyl, Princeton.

### Prof. H. E. Armstrong: Doyen of the Royal Society

WE are glad to have the opportunity of printing the following letter received by Prof. H. E. Armstrong from the president of the Royal Society:

"Dear Professor Armstrong,

"In the name of the Officers and Council of the Royal Society, and in my own, I send you hearty congratulations on your completion of sixty years in the Society's Fellowship and wish you continued health and activity in the years to come.

"Yours sincerely,

"W. H. Bragg, President R.S."

To the Royal Society's greetings we add our own to one who has long been a stimulating—and often provocative—contributor to our columns, and by his teaching and sympathetic guidance, has inspired several generations of students of various branches of chemistry. It may be recalled that on the occasion of Prof. Armstrong's golden wedding, a number of friends and old students presented to him a striking portrait by Mr. T. C. Dugdale, a photograph of which was reproduced in NATURE of September 10, 1927 (p. 379). Prof. Armstrong is the senior fellow of the Royal Society, having been elected in 1876; next in years of service come Sir James Crichton-Browne, elected 1883, and Sir J. J. Thomson, elected 1884. His fellowship of the Chemical Society, of which he was president so long ago as 1893–95, goes back even further, namely, to 1870. Scientific workers everywhere will wish to congratulate Prof. Armstrong on the accomplishment of so many years of fruitful activity.

### Sir Robert Mond and Industrial Chemistry

SIR ROBERT MOND has been elected president of the Société de Chimie Industrielle of France. Sir Robert, who was recently awarded the Messel Medal of the Society of Chemical Industry in Great Britain, is to deliver his medal address, on "Works as I have seen them grow", during the annual meeting of the Society in Liverpool on July 6–10. He has been, and still is, associated with a number of important firms in the chemical industry. A great deal of his original work has been in connexion with electro-chemical processes and industrial chemistry, and he was at one time associated in his work with Lord Kelvin. The Messel Medal of the Society of Chemical Industry is awarded every alternate year to a scientific worker who has attained eminence in applied chemistry.

### Nova Lacertæ 1936

A NOVA of the third magnitude was discovered on the night of June 18–19 by Dr. Nielsen, of Aarhus, Denmark, who happened at the time to be one of a party of astronomers on board the P. and O. steamer *Strathaird* which was going to view the total eclipse of June 19 from a station off the coast of Greece. The nova was observed through cloud in England on the night of June 19–20; estimates of the magnitude were difficult to make on account of the cloud, but the star was probably not brighter than the second magnitude. The spectrum was photographed at Greenwich and found to be of *F* type with strong absorption lines and weak emission bands, recalling the spectrum of Nova Herculis 1934 on December 23, 1934. Unfortunately, the weather has not been favourable for observations in and about London as we go to press, but according to Dr. Steavenson the nova is already decreasing in brightness. An accurate position was obtained at the Royal Observatory, Greenwich, with Airy's transit circle on the morning of June 21 by Mr. Symms, who estimated a magnitude of 3·0 m. The apparent position referred to the equinox of date (June 21, 1936) is R.A. $22^{h}13^{m}22\cdot5_{s}$, Dec. $+55^{\circ}\ 17'\ 51''$. The nova may still be a naked-eye object for a few nights to come: since it is so far north, it is visible throughout these short nights, although the meridian transit takes place in the early morning. The nova should be identified readily as follows. Half-way between the constellation of Cassiopeia and the conspicuous figure of Cygnus is an equilateral triangle of stars formed by $\delta$ Cephei, $\zeta$ Cephei and the nova; half-way between the nova (the southernmost of the three) and $\zeta$ Cephei is a centre star, $\epsilon$ Cephei.

### Louis Pasteur Film

THE Louis Pasteur film, of which a gala first night exhibition took place at the New Gallery Kinema, Regent Street, London, on Monday, June 22, in aid of St. Peter's Hospital, Covent Garden, was in more than one sense a remarkable event. The title role was taken by Mr. Paul Muni, who had obviously made a careful study of the great French savant in all his strength and weakness. Not only were his passionate ardour in research, dauntless courage in facing opposition and sympathy for human suffering admirably portrayed, but also his abruptness, outbursts of temper, and fits of despondency. It is, therefore, all the more regrettable that the film should contain many historical errors. We are shown, for example, Napoleon III, who in actual fact always took a warm interest in Pasteur's investigations, forbidding him to continue his researches on anthrax and to recant what he had already written on the subject, whereas his work on anthrax was not commenced until after the Emperor's death. Lister is represented as making a special journey to France to witness the results of Pasteur's inoculation of sheep against anthrax in 1881, whereas these two great men did not meet until 1892, when Lister represented the Royal Society at the ceremony held at the Sorbonne in honour of Pasteur's seventieth

birthday. Another objectionable feature is that we are shown Pasteur hurrying from one doctor's house to another on a rainy night to find an accoucheur for his daughter, the wife of one of his former opponents, and after a prolonged and fruitless search at last persuading the president of the Académie de Médecine, his chief antagonist, to carry out the confinement under antiseptic precautions. The doctor's consent, however, was only obtained on the condition that Pasteur signed a document to be published in the medical press that his researches in rabies had been a failure.

THE film, therefore, scarcely deserves the high praise given it by certain writers in the daily Press obviously unfamiliar with the details of Pasteur's life and work. A word of commendation, however, must be given to the producers, Messrs. Warner Brothers Pictures, Ltd., for the excellent background representing a doctor's consulting room in pre-antiseptic times, the rural scenery and Pasteur's laboratory. In a film of this sort, intended for entertainment rather than for instruction, it is possibly pedantic to expect absolute historic accuracy. It must be admitted that an average audience will probably obtain from the film some idea of what a scientific attitude implies. They will certainly realise something of the thrill of successful research, as well as the drudgery and self-sacrifice which it involves. Also, there will be no doubt left in their minds regarding the social implications of the work of the man of science. The film was shown by permission of Gaumont British.

### Australian Research Ship

THE Commonwealth Council for Scientific and Industrial Research is about to build a specially designed Diesel-engined steel vessel for an extensive study of fish life in the ocean waters around Australia. Since the loss of the trawler *Endeavour* in 1914, with Dannevig on board and, presumably, the greater part of his records also, no systematic investigation of Australian fishing grounds has been carried on. The new vessel cannot be used for trawling, being designed mainly for the catching of surface swimming or pelagic fish by purse seine (and ring) nets; but it will be able to do a certain amount of work on demersal fish by means of Danish seine nets. The principal fish to which attention will be given at first are pilchards, Australian salmon, garfish, barracouta, members of the mackerel family including tunny, and other edible species. The length of the vessel will be 82 ft. and its beam 19 ft. Its extreme draught will be 8 ft. 4 in., and its displacement 108·5 tons. It will be capable of a speed of nine knots.

### Australian Aborigines and Prospectors

AUSTRALIAN aborigines are said to have attacked and attempted to spear a party of gold prospectors who were searching for Lasseter's Reef, which is supposed to be rich in gold, and has been sought by such expeditions for years. According to reports from Alice Springs, it is stated in a dispatch from the Adelaide correspondent of *The Times* in the issue of June 18, aeroplanes from Sydney reached Mount Bowley, a native reserve fifty miles from the West Australian border, on June 14, and the attack took place while the occupants were awaiting the arrival of the ground party with trucks. The blacks began by firing the porcupine grass, and after one of them had tried unsuccessfully to barter geological specimens, a group in war paint appeared and hurled spears. One prospector narrowly escaped being hit. The white party, which was armed with rifles and revolvers, then attacked and charged several times through the scrub, while further spears were thrown at them. No member of the party was injured. An investigation no doubt will be held. It will be important to know whether the attack was entirely unprovoked, or whether the party had unwittingly infringed what the tribesmen regard as their rights. The name of the tribe responsible is not mentioned, even if known; but neither the Arunta nor their neighbours, the Loritja, to whom the aggressors more probably belonged, according to recent accounts of them, are fiercely aggressive and liable to attack without reason, as are the northern saltwater blackfellows of Arnhem Land, who were responsible for the murder of Trooper McColl two years ago. Fear for their water supply is a frequent cause of trouble, and if prospectors for minerals are to be allowed to enter the reserves—generally it has been understood that this was forbidden—the risks of interference with tribal water-holes should be understood.

### Transport Conditions in New York

AFTER studying transport conditions in America, Mr. J. P. Thomas, the manager of the London Transport Board railways, on his return to London gave an interview which is reported in *The Times* of June 19. He pointed out that New York would probably adopt a unified system of transport similar to that in use in London. He mentioned that the rush-hour problem in New York is as perplexing as in London, and intensive services have to be pressed into operation for very short periods at certain times of the day. In New York, certain business hours have been voluntarily altered by large offices and works so as to mitigate largely these rushes, with satisfactory results. If London firms would co-operate by altering the times of arrival and leaving of their staffs by 20 or 30 minutes, equally satisfactory results could be obtained, especially in the centre of the city. Mr. Thomas comments on the severely utilitarian appearance of New York's stations and on the difficulty of finding them, but he praises the efficiency of the underground staffs. He was impressed by the fact that the acceleration and retardation of trains in New York is much higher than in London, and yet they run equally smoothly. On some of the trains in New York, the acceleration is at the rate of three miles an hour a second and the retardation at the rate of four miles an hour a second. These rates are at least twice the rates at present adopted in London. Experiments have been carried out for some time in London on the 'Metrodyne' train. The experience gained in New York confirms the usefulness of this type of train, and the desirability of higher speeds.

### Submarine Light and its Biological Importance

SINCE submarine light was made accessible to accurate measurements through the development of the photo-electric cell, sub-surface light measurements have attracted an increasing number of workers in different countries. The vast importance of sub-surface daylight as a controlling influence on the photosynthesis of phytoplankton and on the movements of zooplankton has made marine biologists realise the necessity for observing and correlating this factor with phytoplankton growth, with the migrations on zooplankton and of fishes, and with the abundance of year-classes of the latter. At the 1936 meeting of the International Council for the Exploration of the Sea, a special session was devoted to "Submarine Daylight, its Measurement and Biological Effects". The biological importance of extensive observations on sub-surface illumination was especially emphasised by F. R. Russell and G. L. Clarke, both specialists on marine biology, the other authors considering more particularly the physical aspects of the observations.

H. H. POOLE dealt at the meeting with the various sources of error inherent in such measurements, and with the precautions necessary for their reduction or elimination. C. L. Utterback described a long series of measurements on the penetration of various spectral bands in Pacific waters, carried out with apparatus in some respects in advance of any used by other workers. The important question as to the unit of light intensity to be recommended for workers in the field was raised by A. Ångström, who pleaded for the cal./sq. cm./min. unit used in studies of solar radiation in lieu of the less well-defined photometric unit, lux or metre-candle, which is at present widely used. He suggested a method of standardisation by means of sunlight with suitable pyrheliometer measurements. H. Pettersson described his work on the direct measurements of the transparency of sea-water to artificial light. This method enables variations in opacity to be rapidly and accurately examined. Messrs. Ångström, W. R. Atkins (of Plymouth), Clarke, Pettersson, Poole and Utterback were appointed as a special committee for the purpose of working out definite proposals for instruments, methods of measurement, and choice of units, to be laid before the next meeting of the International Council in 1937.

### Congress on Photoluminescence

AN International Congress on Photoluminescence was held under the auspices of the Institute of Experimental Physics of the University of Warsaw and the Polish Physical Society at Warsaw on May 20–25. The central theme of the invited papers and the discussions was the mechanism of production, interpretation and theoretical aspects of absorption, fluorescence, and phosphorescence spectra. Belgium, France, Germany, Yugoslavia, Latvia, Poland, Rumania and the United States were represented by the 149 physicists attending the congress. At the opening ceremony, the members were welcomed by the Polish Minister of Education; and the President of the Polish Republic, who was himself a professor of physical chemistry, received the group at his residence. Papers read and presented at the Congress are being published in a forthcoming issue of *Acta Physica Polonica*.

### Control of Rabbits

AN article on this subject in NATURE of May 16 referred to D. G. Stead's book "The Rabbit in Australia" in which the use of 'Cyanogas' is advocated. Capt. C. W. Hume, honorary secretary of the University of London Animal Welfare Society, which is acting as agent in Britain for Mr. Stead's book, informs us that 'Cyanogas' can be obtained from Messrs. George Monro Ltd., Waltham Cross, Herts, while 'Calcid' is supplied by the London Fumigation Co., Marlow House, E.C.4. A British product known as 'Cymag', having generally similar effects, can be obtained from Imperial Chemical Industries, Millbank, S.W.1. A fairly powerful pump is required and such pumps can be obtained from the above firms or from Messrs. W. J. Craven Ltd., 50 Port Street, Evesham, Worcestershire. Capt. Hume states that the principal obstacles to the control of rabbits are the reluctance of farmers to adopt a new and unfamiliar method and the difficulty of securing concerted action between neighbouring farmers. The following motion, drafted by the University of London Animal Welfare Society, for the appointment of a select committee was moved by Lord Merthyr in the House of Lords on May 14, and carried: "That a Select Committee be appointed to consider whether any measures, and if so what, ought to be taken for better protection of Agriculture and the land against the ravages of rabbits, and to what extent, if any, the prohibition of the use of Gin Traps would affect the attainment of the object aforesaid".

### Lily Year Book

THE Royal Horticultural Society's "Lily Year Book" for 1935 (from the Society's Office, Vincent Square, S.W.1. 5*s*. paper, 6*s*. cloth) is something more than a mere review of progress; some very fundamental contributions are set before its readers. It is perhaps not invidious to give pride of place to Dr. Fred Stoker's "List of Lily Names and Synonyms", as this is a very painstaking and complete attempt to reach orderliness and exactitude in lily nomenclature. Nearly 540 species, varieties, forms and crosses have been considered, accepted names are indicated clearly, and synonyms are printed in italics. Dr. M. A. H. Tincker describes "Experiments with Lilies at Wisley", Mr. W. E. H. Hodson writes on the control of lily pests, and the late Dr. D. Griffiths, an American authority on vegetative propagation of lilies, is represented by an article on "Vegetative Propagation of Hybrid Lily Clons". Mr. J. Ingram ministers to seed propagation by a paper on "Development of Lily Seedlings". Geographical distribution is a fascinating subject, and articles upon the native lilies of western America (Mr. Carl Purdy), eastern Asia (Mr. A. D. Cotton) and Asia Minor (Mr. E. K. Balls) are included. Mr. T. Hay has

reviewed "Some Lily Literature", while the various aspects of garden technique and the horticultural setting for lilies have called forth many articles, and inspired most of the plates. The volume is quite equal to the Royal Horticultural Society's high standard of literary production, and should commend itself to all who take delight in the beauty and skill of the garden.

### The National Physical Laboratory

The Report for 1935 is 249 pages in length and is published at 12*s*. It has the unfortunate duty of announcing the deaths of the first two Directors of the Laboratory. Other changes of staff have been few. At the silver jubilee of King George, medals were awarded to fifteen members of the staff for their distinguished work. The new photometry building has been completed, and it is hoped to make an early start in extending the acoustics building to meet the demand for information as to the sound insulation of floors. A new high-speed wind tunnel of the return flow type and one for investigating the effects of turbulence on larger scale models are under consideration. The general demand for assistance by industry has increased during the year. The provincial lectures on the work of the Laboratory have been continued, more than a dozen towns having been visited. Each department of the Laboratory gives an illustrated account of its activities in language which is not too technical for the average reader. A good example of the result of co-operation between several departments is the proof that the slip bands in a single crystal under stress contain disintegrated crystal fragments of size generally greater than $10^{-5}$ cm. and dislocated grains generally greater than $10^{-4}$ cm.

### Forestry in Great Britain

*Forestry*, the journal of the Society of Foresters of Great Britain (9, No. 2, December 1935. Oxf. Univ. Press) opens with a presidential address to the Society by Sir Alexander Rodger in which he discusses the varying importance which forestry has attained in different countries. After alluding to the different types of areas set apart for the recreation of the public in the United States, Sir Alexander dealt with the position in Great Britain. There is at present an absence of a forestry sense; and owing to this absence the work of the Forestry Commissioners does not prove so easy to carry out as might otherwise be the case. The constitution of an informal committee composed of members of the Council for the Preservation of Rural England and members of the Forestry Commission was alluded to. It is hoped that this committee will help to disseminate a knowledge of the aims of forestry in Great Britain.

### Care of Children and After-care of the Injured

Whereas arrangements for the supervision of the health of children up to the age of two years or thereabouts appear to be generally satisfactory, the Minister of Health does not consider that enough attention is being given in many areas to the health of young children between eighteen months and five years. The Minister has therefore issued a Circular (Circular 1550. London: H.M. Stationery Office. 1*d*.) directing that it is essential that in all areas there should be systematic periodical health visiting of those young children who are not in attendance at school, and making suggestions for 'toddlers' clinics' and day nurseries. A representative Inter-Departmental Committee has also been appointed by the Minister of Health and the Secretaries of State for the Home Department and for Scotland to inquire into the arrangements made in Great Britain for the restoration of the working capacity of persons injured by accidents. This matter arose after consideration of a report upon the treatment of fractures issued in February 1935 by the British Medical Association.

### Czechoslovak Scientific Expedition to Iceland

An expedition to Iceland has been planned for this summer by a party of Czechoslovak men of science. The objects of the expedition include a geological and chemical study of the hot springs, geysers and volcanoes. The botanical members of the party, which is under the direction of Prof. Joseph Kunský, will make as comprehensive a collection of the flora as is possible during their visit. Film photographers are included in the party, and the taking of Nature study films constitutes one of the important objectives of this expedition.

### Giovanni Canestrini

The first centenary of the birth of the eminent Italian naturalist, Giovanni Canestrini, was recently celebrated at Trent on the initiative of the Museum of Natural History and the Society of Studies of Venezia Tridentina, when an address was delivered by Prof. Pasquini. Canestrini was born at Revo near Trent on December 26, 1835. He studied medicine at Vienna under Hyrtl and Brücke and shortly after qualification in 1860 was elected professor of comparative anatomy and physiology at the University of Padua, where he founded a laboratory for bacteriology, and was the first teacher of this branch of medicine. In addition to translating almost all Darwin's books into Italian, he was the author of original works on the fish of Italy, the origin of man, the theory of evolution, a critical exposition of Darwin's theory, Italian arachnids and Italian acari.

### Dresden Meeting of the German Association

The German Association of Naturalists and Physicians (Gesellschaft Deutscher Naturforscher und Aerzte) is to meet this year in Dresden on September 20–23. There were earlier meetings in Dresden in 1826, 1868 and 1907. Dresden has been for long a city of fine arts; its fame is founded on its picture gallery with the Sistine Madonna, its opera and its theatre. For more than a century it has been a nursery of scientific, medical and technical research. More lately it has become a city of public health, since the first international hygiene exhibition in 1911.

There is now a German Hygiene Museum and a Rudolf-Hess hospital; just for this year there is a German flower-show. The invitation is not only to members and to Germans, but also to all whether within or beyond the frontiers who are interested in scientific work in Germany. Applications for regular membership should be made to the G.D.N.A. Geschäftsstelle: Leipzig C1, Gustav-Adolf-Str. 12. Membership cards for the Dresden meeting are 10 RM. for old members but associate members for this one meeting are also admitted at 20 RM. Communications concerning the Dresden meeting only may be addressed to Prof. Dr. Rud. Zaunick, Dresden—A 16, Elisenstr. 4.

SOME of the more general addresses to be given at the forthcoming Dresden meeting concern cosmic radiation, measurement of gravity, intestinal auto-intoxication, chromosomes and heredity, high-frequency oscillations and ultra-sound, filterable virus, recent treatment of bone-fractures, chemo-therapy of streptococcus infections, Röntgen rays, the German Himalaya Expedition and television. The detailed programme will be ready in July. The draft already issued indicates possible sectional sittings (Abteilungssitzungen) ranging from 1a (Mathematics) to 37 (Balneology and Rheumatism). There are also the allied associations (Befreundete Gesellschaften) comprised in the Zweckverband and now forty-three in number. Only some of these are meeting in Dresden, but their additions to the programme include elements beyond uranium, colloid research, heredity, etc.

### Announcements

HIS GRACE THE DUKE OF BEDFORD has resigned from the presidency of the Zoological Society of London after thirty-seven years tenure of the office. The Earl of Onslow has been elected president until the next anniversary meeting. Lord Onslow is president of the Society for the Preservation of the Fauna of the Empire, and has also recently been elected president of the Society for the Promotion of Nature Reserves.

DR. ALEX. R. TODD, Beit Memorial research fellow in the Department of Medical Chemistry, University of Edinburgh, has been appointed to the staff of the Department of Biochemistry of the Lister Institute as from October 1.

MR. E. J. FORSDYKE has been appointed director and principal librarian of the British Museum in succession to Sir George Hill. Mr. F. N. Pryce has been appointed to succeed Mr. Forsdyke as keeper of the Department of Greek and Roman Antiquities, and Mr. E. S. G. Robinson to be deputy keeper of the Department of Coins and Medals.

AN Institute for the Medicine of Sport has been founded at Hamburg under the direction of Prof. W. Knoll.

THE Minister of National Education in Rome has forbidden the professors and assistants of Italian universities to join the Federation of Eugenic Societies, which aims at promoting the eugenic movement in Scandinavian, German and Anglo-Saxon countries, as well as sterilisation and birth control.

THE recently published January–April issue of *Guy's Hospital Reports* represents the centenary number of this well-known medical journal. In an introductory paper, Sir Humphry Rolleston points out that though the first number of St. Thomas's Hospital Report was published in 1835, there was an interval of thirty-four years in which no volumes were published. In addition to numerous contributions to medical science during the last hundred years, the *Guy's Hospital Reports* contain numerous obituary notices of members of the medical school.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant master in the Engineering Department of the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport (July 1).

A civilian senior technical officer in the Admiralty Technical Pool (mechanical engineering)—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (July 3).

A civilian assistant (Grade III) in the Admiralty Technical Pool (electrical engineering)—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (July 3).

A chemist in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.1 (July 4).

An assistant lecturer in agricultural bacteriology in the University of Reading—The Registrar (July 4).

A lecturer in mathematics in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3—The Principal (July 6).

A lecturer in aeronautics in University College, Southampton—The Registrar (July 7).

An assistant lecturer in physics in University College, Gower Street, W.C.1—The Secretary (July 7).

A vice-principal of the Technical Institute, Royal Tunbridge Wells and the Technical Institute, Tonbridge—Dr. J. Lister, Technical Institute, Tunbridge Wells (July 11).

A lecturer in mathematics in the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (July 13).

A secretary and curator of the Jamaica Institute, Kingston, Jamaica—The Secretary, Museums Association, Chaucer House, Malet Place, London, W.C.1 (July 15).

A Corporation professor of electrical engineering in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.1 (July 28).

A lecturer in physiology in the Portsmouth Municipal College—The Registrar.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1076.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Diffraction and Selective Adsorption of Atoms at Crystal Surfaces

IN two interesting papers on the reflection and diffraction of helium from crystal surfaces, Frisch and Stern[1] have shown that reflected and diffracted beams are sometimes unexpectedly weak. They examined the conditions under which this anomalous behaviour occurred, and found that it depended on the existence of a relation between the components of momentum of the impinging atoms. The results are reproduced in Fig. 1. Each small circle gives the

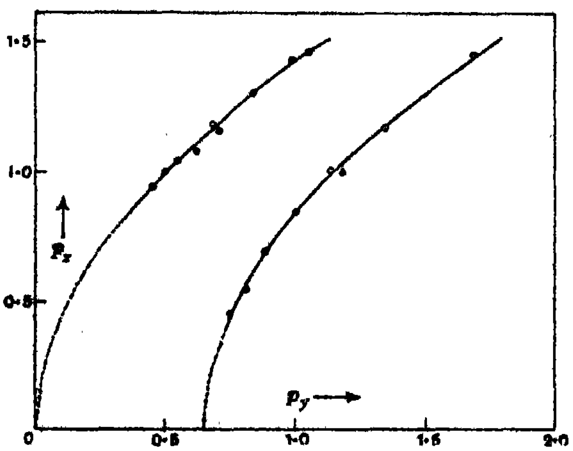


FIG. 1. The experimental results of Frisch and Stern and the theoretical curves.

relation between the component of momentum parallel to one of the axes in the surface lattice ($p_y$) and that perpendicular to the surface ($p_z$) for an incident beam which gave weak reflection. Each dot gives the components of momentum of a weak diffracted beam ($p_y'$ and $p_z'$). This figure shows clearly that the relation between $p_y$ and $p_z$ for weak reflection is the same as that of $p_y'$ and $p_z'$ for weak diffraction, and that the sets of points lie on two distinct curves.

These results may be explained quite simply. The potential field between an atom such as helium and a solid such as lithium fluoride can be represented by the first few terms of a Fourier expansion:

$$V_0(z) + V_1(z)\,[\cos ax + \cos ay] + V_2(z)\,[\cos 2ax + \cos 2ay] \quad . \quad . \quad . \quad (1)$$

where $x$ and $y$ are suitable rectangular co-ordinates in the surface and $z$ is normal to it. The function $V_0(z)$ must be such as to have a single minimum at a finite distance ($z = z_0$) from the surface, and for each value of $z$ the magnitudes of $V_1$ and $V_2$ may be taken to be small compared with $V_0$. If there were no periodic terms in $x$ and $y$, the motion in $x$ and $y$ would be unquantised and that in $z$ would have a finite number of discrete negative energy levels (reckoned from a zero in which the atom is at rest at infinity) and a continuous positive range. All atoms would then be perfectly reflected if there were no interchange of energy at the surface.

The periodic field along the surface, represented by the second and third terms, causes diffraction. The solution of the appropriate wave equation for the motion in a field of the type (1) contains terms which correspond to first order diffraction with momenta components of $p_x \pm ah/2\pi$, $p_y \pm ah/2\pi$, and terms which correspond to second order diffraction. One such diffracted beam has components of momentum $p_x'$, $p_y'$, $p_z'$ given by

$$p_x' = p_x, \quad p_y' = p_y + \frac{ah}{2\pi}, \quad p_z'^2 = p_z^2 - \frac{ah}{\pi}p_y - \frac{a^2h^2}{4\pi^2} \qquad (2)$$

when there is no change of energy at the surface.

These relations hold for all positive values of $p_x$, $p_y$ and $p_z$, provided $p'_z$ is positive. When the expression for $(p'_z)^2$ becomes negative, a diffracted beam of the type $p_y + ah/2\pi$ will not occur. But an exceptional case occurs when the relation between $p_z$ and $p_y$ is such that

$$p_z^2 - \frac{ah}{\pi}p_y - \frac{a^2h^2}{4\pi^2} = -2mE_r, \quad . \quad . \quad . \quad (3)$$

where $E_r$ is one of the quantised levels of an adsorbed atom in the field $V_0(z)$. The atom is then no longer diffracted at a finite angle from the crystal, but ricochets along it with positive $p_x$ and $p_y$ and an oscillatory motion in $z$. The atom is captured by the surface field of the solid, a process which we may call *selective adsorption*. This causes a weakening in the intensity of the reflected beam.

The parabolic relation (3) fits the observations of Stern and Frisch remarkably well, as may be seen from Fig. 1 (where the unit of momentum is $ah/2\pi$). From the fact that there are two such parabolas, we infer that there are at least two oscillatory states for an adsorbed helium atom on lithium fluoride. The values of the energy levels thus deduced are $-57 \cdot 5$ cal. and $-129$ cal. If the latter is the lowest energy level, then this is equal to the heat of adsorption.

The weak *diffracted* beams can be explained in a similar way as due to the capture of the second order diffracted beam. It is easy to show that the condition for this is

$$p_z^2 - \frac{2ah}{\pi}p_y - \frac{a^2h^2}{\pi^2} = -2mE_r, \quad . \quad . \quad (4)$$

which, using (2), is equivalent to a relation between $p'_y$ and $p'_z$ exactly the same as (3).

The critical directions of the incident beam which lead to selective adsorption are given by the curves

of intersection of the parabolic cylinders (3) and (4) and a sphere the radius of which is equal to the momentum ($P$) of the incident beam. (These curves also lie on the circular cylinders $p_x^2 + (p_y + nah/2\pi)^2 = P^2 + 2mE_r$ where $n = 1$ and $2$.)

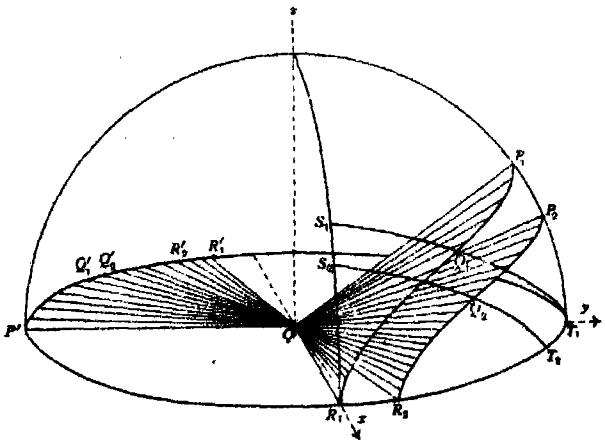


Fig. 2. The critical directions for selective adsorption.

The directions given by (3) are illustrated for a particular case in Fig. 2. The directions of the lines joining the curves $P_1R_1$, $P_2R_2$, . . . to the origin are the critical directions. For each such incident direction there is a diffracted beam $OP'$, $OR'$ . . . in the plane of the crystal. There are similar critical directions $S_1T_1$, $S_2T_2$ . . . obtained by changing $p_y$ to $p_x$ in the equations (3) and (4). The direction $OQ_1$, where $Q_1$ is the point of intersection of $P_1R_1$ and $S_1T_1$, is doubly critical, for atoms may then be selectively adsorbed in two ways. As the radius of the sphere changes, the point $Q_1$ will trace out a parabola in the plane $p_x = p_y$. A tangent to this parabola will give the direction where the most pronounced effect may be expected, when a non-monochromatic beam is used, provided the mean energy has the right value.

The fact that the theory here given is successful in explaining the observations suggests that helium atoms moving with the energy of the beams which Stern and Frisch used (corresponding to a temperature of 300° absolute) migrate freely along the surface. It seems reasonable, too, to infer that the inverse process takes place in Nature. Atoms moving along the surface with the right energy and in the right direction may be diffracted so as to leave the surface with positive energy and thus be evaporated. This is a new mechanism of evaporation which has not previously been suspected.

J. E. Lennard-Jones.
A. F. Devonshire.
University Chemical Laboratory,
Cambridge.

[1] Frisch and Stern, *Z. Phys.*, **84**, 430 and 443 (1933).

## Raman Spectrum of Gaseous and Liquid Sulphur Dioxide and its Solutions in Water

The Raman spectrum of *gaseous* sulphur dioxide at a pressure of 12 atmospheres was determined with large dispersion (Hilger $E_1$ spectrograph). Only the strong frequency 1150·5 ± 0·5 was found, whereas Bhagavantam[1] gives 1154. The two weak, diffuse lines of the molecule could not be obtained, probably owing to the fairly strong background inevitable in very long exposures.

The frequencies of the liquid were redetermined, and the influence of the temperature on them was studied at 30° and 80°. Only a small displacement of the strong, sharp line towards higher values, with increasing temperature, was found (1144·3 ± 0·2 at 30°; 1144·9 ± 0·3 at 80°). No influence on the broad and diffuse lines 524·5 ± 1 and 1336·0 ± 1 was perceptible.

For the frequencies of the $SO_2$ molecule in water solutions at 60° the values 531 ± 1 (0, br., diff.), 1150·0 ± 0·5 (4 sharp) and 1331 ± 1(½,d) were obtained. No lines attributable to the ions $SO_3''$ or $HSO_3'$ were found. (As the solution, although it was freed from oxygen and kept in an evacuated, sealed tube, became yellow owing to disintegration, very long exposures were impossible.) It is interesting to note that the larger part of the $SO_2$ molecules in the solution are present as such, and that the frequency of the stronger Raman line agrees nearly completely with that of the gaseous $SO_2$ itself. The state of the molecules in the solution is apparently comparable with that in the free gas.

H. Gerding.
W. J. Nijveld.
Laboratory of Inorganic and Physical Chemistry,
University, Amsterdam.
May 11.

[1] Nature, **126**, 995 (1930).

## Artificial Radioactivity giving Continuous γ-Radiation

In many cases of nuclear transformations, unstable nuclei are obtained which break down emitting positive electrons (β+-decay). Because this nucleus is surrounded by orbital negative electrons, the positive electron produced can recombine with one of the negatives giving rise to a γ-ray quantum[1]. The force responsible for recombination is proportional to $e$ (electronic charge). The probability of such a recombination thus involves the factor $e^4$. Therefore the ratio of the probability of observing a γ-ray quantum to that of finding a positive electron must be of the order of magnitude $e^2/hc \sim 10^{-2}$ ($e^2/hc$ being the only dimensionless number which can be formed from $e$, the Planck constant $h$ and the velocity of light $c$).

We conclude that any β+-emission must be accompanied by a weak γ-radiation. In analogy to the theory of optical dispersion, we can consider the decayed nucleus plus the (positive and negative) electrons as an *intermediate state*. If a transition from the *initial state* (non-decayed nucleus plus orbital electrons) to the *final state* (decayed nucleus plus a γ-ray quantum) is energetically possible, such a transition can occur even if the energy is too small to reach the *intermediate state* (decayed nucleus plus positive electron plus orbital electrons).

Artificial β+-activity occurs, if the energy difference between the decayed and the undecayed nucleus is greater than $mc^2$. Emission of a continuous γ-ray spectrum (not accompanied by β+-emission) should be observed if this energy difference is less than $mc^2$, but greater than $-mc^2$. The mean life of such a γ-active nucleus is about a thousand times longer than that of a β+-active nucleus. It seems worth while to look for this new form of radioactivity.

*Note added in proof:* Only in one of 137 cases of decay is a $\gamma$-quantum emitted. In all other cases an unobservable and monochromatic neutrino radiation appears. Prof. W. Pauli remarked in a discussion that this radiation must be followed by emission of the characteristic X-ray spectrum of the atom preceding the unstable element in the periodic system. A complete account will be published in the *Helv. Phys. Acta.*

E. C. G. STUECKELBERG.

Institute of Physics,
University of Geneva.
May 7.

[1] Bloch and Møller, NATURE, 136, 911 (1935); M. Fierz, *Helv. Phys. Acta*, 9, 245 (1936); G. Rumer, *Sow. Phys.*, 9, 317 (1936).

## Distribution of Atomic Nuclear Spins

I HAVE previously pointed out[1] that the distribution of atomic nuclear spins appears to be entirely different in the two types of odd atomic weight nuclei, namely, class $A$, those possessing an odd nuclear proton, and class $B$, those possessing an odd nuclear neutron. Since then quite a number of nuclear spins have been added to those known, data now being available for sixty-four elements, among which are seventy odd isotopes and seven even atoms. Improved distribution curves can thus be drawn, as in the accompanying diagram (Fig. 1). The full lines show the spin values known with certainty, and above these (dotted) are included the spins about the value of which there is yet some doubt (generally occasioned by the observation of fine structure in terms with $J$ values insufficient to permit full fine structure multiplicity to be reached).

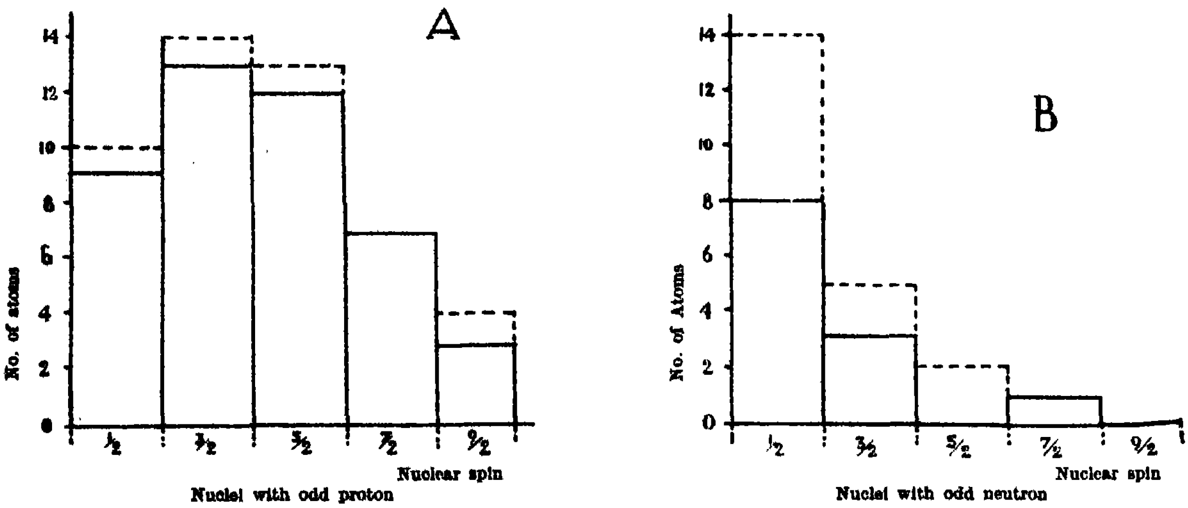


FIG. 1. Distribution of nuclear spins among the odd atomic weight atoms.

Inglis[2] has discussed this distribution with relation to the stabilities of the nuclear particles. The most striking feature of the curves is the preponderance of the spin $\frac{1}{2}$ in class $B$ nuclei (and of low values in general in this group). The improved curves show even better than before, that, as I have already suggested, in class $B$, neutron spin and orbital moments tend to oppose each other. This explains the differences in the two curves. According to the theory of Tamm and Altschuler[3] the total neutron spin in a nucleus can have the value $\frac{1}{2}$ or $\frac{3}{2}$ according to circumstances. Thus a nuclear spin of $\frac{1}{2}$ will tend to arise from orbital moments ($l$ values) of 0, 1 and 2 (and possibly even from 3 and 4 if cases exist in which five neutron spins add together). Further, $l$ values of 2 and 3 would tend to give nuclear spins of $\frac{3}{2}$ and so on. This view, therefore, accounts for the preponderance of spins of $\frac{1}{2}$ and of low values in general. In class $A$, only $l$ values of zero produce spins of $\frac{1}{2}$ with certainty, $l$ values of 1 resulting in both $\frac{1}{2}$ and $\frac{3}{2}$ spin values.

The distribution of the spins of even atomic weight atoms has received practically no attention. In 1932[4] I pointed out a relationship between nuclear spin and mass defect in the lighter elements. Only the atoms on the lower spur of the mass defect curve (atomic weights multiples of 4) definitely have zero nuclear spin. All the odd atoms and a number of even atoms lie on the upper spur. It was suggested that the less tightly bound particles which cause the large positive mass defect are likely also to produce nuclear spin. At that time the spin of $^{14}N = 1$ was the only spin greater than zero known to be exhibited by an even atom. I predicted, from the mass defect curve, spins of 1 for $^{6}Li$ and $^{10}B$. We now know that the spins of the atoms $^{2}H$, $^{6}Li$, $^{14}N$ are equal to 1. All lie on the upper spur, and therefore it is now very reasonable to predict a spin of 1 for $^{10}B$.

With regard to $^{16}O$ and onwards, Bartlett's evidence[5] for the beginning of a new nuclear shell at $^{16}O$ suggests that any prediction for $^{16}O$ and onwards must be accepted with caution. Thus in Bartlett's first group, the even atoms divisible by four all have zero spin and the others have a spin of 1, if the view put forward here is correct. In the latter cases the spin is due to the odd neutron and proton combining with mechanical moments in parallel, and as the magnetic moments of these particles are of opposite signs, the resulting $g(I)$ factors will be small and therefore the fine structures will be minute. This has been observed in the fine structures of $^{6}Li$ and $^{14}N$, and may be expected for $^{10}B$.

S. TOLANSKY.

Physics Department,
University, Manchester.
April 22.

[1] NATURE, 135, 620 (1935).
[2] Inglis, NATURE, 135, 998 (1935).
[3] Tamm and Altschuler, *C.R. Acad. Sci. U.S.S.R.*, 1, 455 (1934).
[4] *Z. Phys.*, 78, 71 (1932).
[5] NATURE, 130, 165 (1932).

## Anomalous Values of Lattice Spacings obtained by Electron Diffraction

SEVERAL observers have recently reported discrepancies in the lattice spacings calculated from the ring or spot patterns given by electron diffraction. When the thin film traversed by electrons ($\sim 30$ k.v.) contains two crystalline substances, the ratios of the spacings are not always in accord with those given by X-ray diffraction. The variations are of the order of 1 per cent, and are far greater than can be accounted for by experimental error.

G. I. Finch and S. Fordham[1] have shown that this is so in the case of the alkali halides referred to gold as standard, and Dr. E. R. Cooper and I[2] obtained discrepancies in the case of two metals aluminium and bismuth, and in metal-metal oxide patterns, $Bi-Al_2O_3$, $Zn-ZnO$, $Cd-CdO$. Finch and Fordham find that $a$ for NaCl (assuming the X-ray constants for gold) $= 5 \cdot 666$ A., using NaCl films 'flashed' *in vacuo* ($a$ for NaCl (X-ray) $= 5 \cdot 628$ A.).

V. E. Cosslett[3], using films formed by evaporation of a dilute salt solution, has reported variations of $a$ with order of reflection, which he suggests are due to refraction or surface lattice effects.

J. Gnan[4], in a measurement of $h/m$, has calibrated NaCl against Bi, using a thin collodion film on which NaCl has been evaporated on one side and Bi on the other, in a high vacuum. He finds $a$ for NaCl (Bi) $= 5 \cdot 640 \pm \cdot 003$ A. I found, however, also using evaporated films of chemically pure NaCl and Bi, that $a$ for NaCl (Bi) $= 5 \cdot 668 \pm \cdot 005$ A. Photographs with different exposures gave the same value for $a$, which does not suggest any charging-up effects or heating effects due to inelastic electronic collisions. The constancy of $d_{hkl} \sin \theta$ and the sharpness of the rings appear to preclude effects of refraction or of lattice distortion, and further, the small half-breadth indicates comparatively large crystallites of NaCl and Bi.

Although slight variations in the NaCl lattice spacing have been found by X-ray work[5], these are of the order of 0·01 per cent, and so much smaller than the discrepancies under consideration.

At present, the most reasonable explanation of these anomalies seems to be that of variation of lattice dimensions with crystal size for small crystals, as emphasised by Finch[1]. The use of films evaporated *in vacuo*, the normal relative intensities of the rings, and the absence of extra rings or bands makes improbable any lattice expansion due to gas absorption. On the other hand, the binding in Bi is of a homopolar nature[6] (valency link binding), whilst the NaCl lattice is governed mainly by ionic forces, so that, according to the simple theory of Lennard-Jones, $a$ for NaCl(Bi) should be less than $a$ for NaCl (X-rays), whereas experimentally the reverse is found.

These anomalies may invalidate the results of electron-wave methods for measuring atomic constants, as in the case of Gnan and possibly of S. v. Friesen[7], the latter's results depending on the cross grating pattern obtained by transmission of electrons through the very thin fragments projecting on the surface of an etched crystal. Whatever the origin of the discrepancies we have been discussing, their existence is amply proved, and measurements by electron diffraction can scarcely yet be trusted to give accurate relations between the fundamental physical constants.

It is hoped to obtain more definite evidence by using films of bismuth evaporated on to a cleavage flake of mica, since the mica spacings should be reliable, and the Bi rings can be compared with the spot ($N$) pattern given by the mica.

E. PICKUP.

Physical Laboratory,
University, Manchester.
April 30.

[1] *Proc. Phys. Soc.*, 48, 264 (1936).
[2] Unpublished.
[3] *Trans. Far. Soc.*, 31, 1119 (1935); NATURE, 136, 988 (1935).
[4] *Ann. Physik*, 20, 361 (1934); A. H. Jay's X-ray values for the Bi lattice have been used, *Proc. Roy. Soc.*, A, 143, 465 (1933).
[5] "X-Rays in Theory and Experiment", Compton and Allison, 1935, p. 677.
[6] F. Hund, Report Int. Conference Physics, p. 36, 1935.
[7] NATURE, 135, 1035 (1935).

## Propagation of Electromagnetic Waves

IN view of the interpretation of measurements concerning the reflection of radio waves by the ionosphere, it is desirable to calculate the reflected amplitude for a special case, making certain suppositions about the electric properties of the ionosphere and assuming an external magnetic field. I have therefore investigated the propagation of electromagnetic waves in a vertical direction in a medium with electric properties varying in the same direction, and subject to the influence of a constant magnetic field $H$ making an angle $\Theta$ with the vertical.

Studying the case of free ions in a gas (ionosphere) and in an alternating electric field, we can obtain a formula for the mean ionic current density and we can deduce an expression for the dielectric constant $\varepsilon$ and the conductivity constant $g$. Certain assumptions were made by G. J. Elias as to the mean free path of an electron and as to the temperature, and he obtained[1], for the case of ionisation caused by ultra-violet radiation, the following expressions for $\varepsilon$ and $g$, being functions of the height above the earth:

$$\varepsilon = 1 - \eta e^{kz}, \quad g = \frac{\omega}{4\pi} e^{kz},$$

where $z = 0$ is a fixed plane in the ionosphere, and $\eta$ and $k$ are constants, depending on the physical properties and the condition of the medium.

Owing to the presence of a constant magnetic field, the relations between the ionic current and the electric force components are given by a tensor (as is the case in any anisotropic medium). Using Elias's assumptions, the components of this tensor $\tau$ have been calculated.

A system of axes was introduced, the positive $z$-axis being in the vertical direction, the $y$-axis lying in the $H-z$ plane and the $x$-axis perpendicular.

With the components of $\tau$ and putting $\mu = 1$, I derived from the Maxwell equations two simultaneous equations of the second order for $E_x$ and $E_y$. These equations can be connected in such a way that two ordinary equations for $E_x \pm iE_y$ are obtained.

In obtaining this result, I neglected some terms; this being permissible for sufficiently short waves and for a sufficiently small value of $H$. Strictly, the reflected waves are elliptically, when the incident ones are circularly, polarised.

So we have one wave, characterised by

$$\begin{aligned} E_x + iE_y &\neq 0 \quad (+\text{wave}) \\ E_x - iE_y &= 0 \,; \end{aligned}$$

and the other by $E_x - iE_y \neq 0$ (−wave)
$$E_x + iE_y = 0.$$

When propagated along the $+z$-axis, the +wave is righthanded polarised; and when propagated along the $-z$-direction, being the direction in which reflection takes place, the +wave is lefthanded. The +wave will hence be called lefthanded and the −wave the righthanded one.

The equations for $E_x \pm iE_y$ can be transformed into two Bessel equations with complex argument and imaginary order. Now the solution shows a certain point where the absolute value diminishes rapidly with increasing height[3]; this point lying at a different height for the right- and the lefthanded waves. When the $z$-component of $H$ is negative, this 'reflection point' is higher for the lefthanded wave; but, on the other hand, the absorption is found to be less for this one. As might be expected, this has opposite effects upon the reflection coefficient. Finally, the reflected amplitude for the lefthanded wave is found to be greater than that for the righthanded one; the incident amplitudes being equal.

With the opposite sign of $H_z$, the same result is found for the righthanded wave.

Elias pointed out the following relation between the amplitudes of the reflected and the incident waves in a medium without magnetic field and

$$\varepsilon = 1 - \eta e^{kz}, \quad g = \frac{\omega}{4\pi} e^{kz}.$$

This relation was proved[3] to be: $e^{-p/\eta}$.

In my case this relation for the lefthanded wave is given by $e^{-\frac{p}{\eta}\left[\frac{\eta - 2\eta_1 \cos\Theta}{\eta - \eta_1 \cos\Theta}\right]}$; and for the righthanded one by $e^{-\frac{p}{\eta}\left[\frac{\eta + 2\eta_1 \cos\Theta}{\eta + \eta_1 \cos\Theta}\right]}$.

Any reflected wave can be decomposed into a right- and lefthanded wave and so, the incident wave being linear, the relation between their amplitudes is given by the quotient of the two expressions above ($\eta$ is taken as large, which is true for short waves), namely:

$$e^{2p\frac{\cos\Theta . h}{\eta}} \quad h = \frac{qH}{mc\omega}.$$

The following are the meaning of symbols used above:

$\eta$ = quantity in the expression for $\varepsilon$.
$\eta_1$ = " " " " $\tau$; $\eta_1 = \eta \frac{qH}{mc\omega}$.
$k$ = exponential constant, determining the variability of $\varepsilon$ and $g$.
$\omega$ = frequency multiplied by $2\pi$.
$c$ = velocity of light *in vacuo*.
$\Theta$ = angle between $H$ and the $z$-axis.
$p$ = $2\omega/ck$.
$q$ = charge of an electron ($q$ being negative).
$m$ = mass of an electron.

C. TH. F. VAN DER WYCK.

74 Laan Copes van Cattenburgh,
The Hague,
April 19.

[1] G. J. Elias, *Tydschrift v. h. Nederl. Radio Genootschap Maart* 1926, deel III, no. I.
[2] G. J. Elias, *Proc. Inst. Radio Eng.*, May 1931.
[3] G. J. Elias, *Elektr. Nachr. Technik*, 8, 4 (1931).

## Line on the Surface of Water

I WAS interested in Prof. W. Schmidt's letter in NATURE of May 9, as nearly thirty years ago I noticed the 'line' he describes and have often seen it since, but not previously in print. I first noticed it on the surface of water in a stone drinking-trough at a farm-house in Hayfield, near Stockport. Water came into the trough at the back and left it by overflowing at a notch in the front side. The 'line' was seen curving round the outlet (Fig. 1). I concluded at the time that the surface of the water at the back of the trough was covered with an invisible film which had been partly removed by the action of the

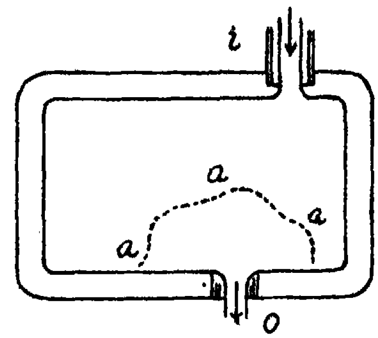


FIG. 1. Sketch of stone drinking-trough showing the water inlet, *i*, the overflow, *o*, and the line, *a*, *a*, on the surface.

overflow, and that the 'line' marked the boundary between the clean water surface in front and the film behind. I tried the effect of allowing a few drops of soapy water to fall into the trough, and found that the line vanished, but it reappeared in a few minutes closer to the overflow than before and then slowly moved backwards over the surface, indicating, as I supposed, the gradual cleaning of the surface by the overflow.

Having once observed the effect, one often notices it. In Southampton I saw it several times at Woodmill, where the water of the River Itchen goes into

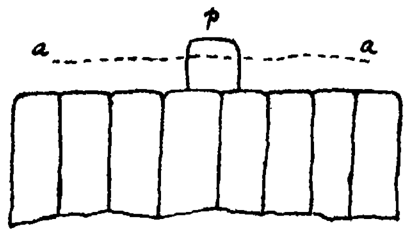


FIG. 2. Sketch of the front end of the raft. *p* is a projecting plank an inch or two below the surface of the water; *a*, *a*, is the line on the surface.

the old mill through a grid of iron bars. There was usually an accumulation of floating material close to the bars, and the surface contamination extended a few feet up-stream. The 'line' was often visible, apparently marking the boundary between the stationary film-covered surface and the cleaner moving surface of the approaching water.

I photographed the 'line' a few years ago from a raft on a little lake or pond at Fionnay in Switzerland. It was particularly well marked one day after rain when the surface of the water was covered in places with some material apparently washed down from trees growing on the bank. The trees were conifers

so the material was probably resinous. When the raft was moving, it carried some of the surface layer along with it, and the line could be clearly seen travelling over the surface of the water but stationary with respect to the raft and a short distance in front (Fig. 2). As the sun was shining, I obtained photographs like Fig. 1 of W. Schmidt's letter, showing the bright line image formed by the 'line' on the bottom of the pond.

My son, who helped me to obtain the photographs at Fionnay and is now at Cambridge, supplied me with the sketch in Fig. 2 and confirms my recollections. He adds: "I often see the line on the river here; in any place where water is eddying up from below there may be a patch of clean surface marked with the bright line of boundary."

HERBERT STANSFIELD.

"Maloca", South Drive,
Ruislip, Middlesex.
May 18.

### International Congresses of the Science of Man

ON my return to Edinburgh, my attention was directed to an article in the *Edinburgh Evening News* of May 5, headed, "Are you an Aryan ?". It reports "a conference, preliminary to the first general congress of the new International Association for Ethnology to take place in Edinburgh next year", that "met in the Deutsche Forschungsgemienschaft" [*sic*]. Seeing that the International Congress of Prehistoric and Protohistoric Sciences holds its second meeting in Oslo this year, the International Congress of Anthropological and Ethnological Sciences in Copenhagen in 1938, the utility of a third organisation might be questioned.

I should not, however, trespass upon valuable space in NATURE to discuss questions of convenience. The next sentence in the newspaper article raises much graver issues. It runs: "The German Research Institute propose to pay the entire cost of printing involved in the production of an atlas of ethnology covering *all* Northern Europe". In view of the connexion between ethnology and the political philosophy of the Third Reich, one wonders whether this generosity is entirely inspired by a disinterested desire to further international science or an attempt to secure "that recognition in kindred countries that the Nordic peoples must feel themselves a *Schicksalgemeinschaft*" desired by Reichsminister für Innern, Dr. Frick, in his circular, translated in NATURE of February 24, 1934.

As representative of the Royal Society of Edinburgh at the First International Congress for Anthropological and Ethnological Sciences and of the University of Edinburgh at the Oslo Congress, I feel bound to direct the attention of readers of NATURE to this engagingly frank report lest they find themselves supporting an organisation in competition with the two *genuinely* international congresses. These, it may be recalled, were established to deal with every aspect of the science of man precisely because the immediate successor of the pre-War "Congrès international d'anthropologie et d'archéologie préhistoriques" was held to be constituted *on a too* definitely 'Ally' basis, to the detriment of scientific workers from 'ex-enemy' countries.

V. GORDON CHILDE.

Department of Prehistoric Archæology,
University, Edinburgh.
May 29.

### A Tribute to NATURE

I AGREE with Snawley that "She [Natur] is a holy thing"; some readers may think with Mr. Squeers "She's a rum 'un", too, at times. Many therefore will have welcomed in your obituary notice of Sir Frederick Macmillan, in NATURE of June 6, the feeling reference to the great service the Macmillan firm has rendered to the cause of scientific progress, by the faith that it has shown in the journal and the freedom that has been accorded to critical contributors to its columns. The firm may even have taught their first editor a thing or two: I can recollect early tussles with him for freedom of expression, which were quite amusing. At one time, J.N.L. was definitely the editorial Hitler. Probably there is no journal with less editorial bias—certainly none which so nearly approaches to being completely scientific in its breadth and fullness of outlook.

I am led to think that I shall not be presuming if, as a senior, speaking for the scientific brotherhood at large, I re-echo with all possible fervour your expression of our indebtedness to the Macmillans. NATURE may not have paid its way over a considerable period; none the less, from the beginning, it must have been an asset of special value to the firm. The position taken by the journal, throughout the cultured world, is indeed unique. NATURE *is* a holy thing. May it continue to be so regarded and be kept whole: no light task. I have already expressed my anxiety, in reviewing Sir Norman Lockyer's Life (Dec. 8, 1928). One pressing need is to simplify the language—if such a word can be applied—in which communications are made. If nations be not yet on terms of mutual understanding, the world of scientific workers is clearly prepared to work in harmonious co-operation and even to mix with the public on equal terms: jargon, not language, alone forbids; this must be stamped out; its use is due both to conceit and to lack of thought; knowledge has to be made the common property of the world. The late Prof. Sylvester saw in the very title NATURE an effulgent blaze of possible ideas. Such a dream was permissible to one who could discuss the philosophy of *The Mathematical Forms called Trees*. In the interval, an effulgent blaze of scientific achievement beyond all dreams has, without doubt, been placed upon record in the columns of this journal. It is no longer the concern of an individual firm: it is a national asset—a trust. You, in your forty-three years of service, have done much to further the good work—may it be permitted to you at least to celebrate your jubilee in office and within the period to make due provision for the future.

HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E.13.

[AFTER the publication of the Jubilee issue of NATURE, on November 6, 1919, many congratulatory messages from leading scientific men and societies at home and abroad were published in the issue of the following week. It is kind of Prof. Armstrong to express similar appreciation now, particularly of the part played by the publishers in establishing the journal. From the editorial point of view, all we wish to say in grateful acknowledgment is that the position which NATURE occupies as an international organ of scientific work and opinion is due solely to the active interest and co-operation of scientific men themselves.—EDITOR.]

## Occurrence of Rotenone in *Tephrosia macropoda* Harv.

IN an investigation of the contact insecticidal properties of a number of tropical plants, Tattersfield and Gimingham[4] found that the roots of a specimen of *T. macropoda* Harv. from Natal possessed a definite toxicity to *Aphis rumicis*. Other members of the genus known to possess insecticidal action have been examined chemically[1,2,3,5,6], and have been found to contain members of the rotenone group of fish-poisoning compounds. We have recently been able to carry out preliminary tests upon a specimen of *T. macropoda* kindly sent to us by the Natal Herbarium, Department of Agriculture, Durban. The material was collected by Mr. Moses, agronomist attached to the African Explosives and Industries, Ltd.

Qualitative insecticide tests using a cold alcoholic extract of the finely-ground root diluted with saponin solution were made upon *Aphis rumicis*. At concentrations equivalent to 0·25 and 0·1 per cent of the root, the percentages of moribund and dead insects recorded on the third day after spraying were 95 and 50 per cent respectively. The root thus shows a decided toxic action to this insect.

When an ether extract, amounting to approximately 4 per cent of the root, was taken up in warm carbon tetrachloride and allowed to stand overnight, crystals were deposited. These after recrystallisation from absolute alcohol melted at 162° C., and showed a methoxyl content of 15·75 per cent. There was no depression of the melting point on admixture with pure rotenone. The rotenone was present to the extent of 0·3–0·4 per cent of the root. By steam distillation of the resin extracted from the root by means of alcohol, 'tephrosal' was obtained. Other crystalline derivatives of the rotenone group were isolated, but the work is to be extended, and the detailed examination of the roots will be reported later.

It would appear, however, that *Tephrosia macropoda*, which is to be found to varying extents over the greater part of South-East Africa, merits further investigation of its insecticidal properties, and it may well be that, by selection and suitable cultural means, a sufficiently rich variety could be obtained which would prove of value, particularly for the control of local insect pests.

J. T. MARTIN.

Dept. of Insecticides and Fungicides,
Rothamsted Experimental Station,
Harpenden.

[1] E. P. Clark, *J. Amer. Chem. Soc.*, **52**, 2461 (1930).
[2] E. P. Clark, *Science*, **77**, 311 (1933).
[3] M. Hanriot, *C.R.*, **144**, 150 (1907).
[4] F. Tattersfield and C. T. Gimingham, *Ann. App. Biol.*, **19**, 253 (1932).
[5] R. R. Le G. Worsley, *Ann. App. Biol.*, **21**, 649 (1934).
[6] *Bull. Imp. Inst.*, **13**, 61 (1915).

## New Alkaloids of Ergot: Ergosine and Ergosinine

WE recently reported[1] the isolation of a new ergot alkaloid which was characterised mainly by its phenolic properties, the m.p. 228° (decomp.), the specific rotation $[\alpha]^{20^\circ}_{5461}$ +522° (in chloroform, $c = 1$), the sparing solubility in methyl alcohol and the ease with which it crystallises. It was assigned a provisional formula $C_{30}H_{35}O_5N_5$.

The high dextro rotation suggested that the substance was a member of the group which includes ergotinine, ψ-ergotinine, ergotaminine and ergometrinine, all of which have high dextro rotations in chloroform solution, and that like these alkaloids it might be convertible into an isomeric or analogous alkaloid by treatment with acids. This is in fact the case, and the alkaloid, $[\alpha]^{20^\circ}_{5461}$ +522°, for which we propose the name ergosinine has been converted in this way into a new alkaloid with the specific rotation $[\alpha]^{20^\circ}_{5461}$ −194° (in chloroform, $c = 1$), for which the name ergosine is suggested. It melts at 228° (decomp.), retains the phenolic properties of the parent substance and crystallises with ease from a number of solvents. Analyses of the crystalline base are in agreement with the formula $C_{30}H_{35}O_5N_5$, and ergosine and ergosinine are therefore isomeric.

S. SMITH.
G. M. TIMMIS.

Wellcome Chemical Works,
Dartford.
May 27.

[1] NATURE, **137**, 111 (1936).

## Occurrence of *Saccocirrus* in Western Canada

THERE appears to be no record of the occurrence of any member of the Archiannelida from the west coast of North America; indeed any records outside Europe seem to be rare. It is therefore of interest to note the appearance of enormous quantities of a *Saccocirrus* at Departure Bay, B.C., during the past month. They were first found at a point marking the entrance to the bay from the open Strait of Georgia in the surface layer of a rather coarse sand-bed at the low limit of a low spring tide on April 23. At this time they were so thick in the sand that every cubic inch contained a hundred or so individuals. Mature representatives of both sexes were present. On April 25 there did not seem to be so many, but this may have been due to the fact that the tide did not reach so low a mark. The appearance is the more interesting in that I have visited the beach on which the *Saccocirrus* was found at the low tides in April, more or less regularly, for the past fifteen years or so, and, to the best of my knowledge, it was never present before.

It is uncertain to what species the specimens should be attributed. In size and in the character of the setæ they correspond to *S. papillocercus* Bobretzky, but the anal lobes resemble those of *S. major* Pierantoni more closely. Possibly they represent an undescribed species.

The only record I have been able to find of the occurrence of a *Saccocirrus* in the North Pacific area is that by Uchida of *S. major* Pierantoni, from Japan[1].

E. BERKELEY.

Pacific Biological Station,
Nanaimo, B.C.
May 13.

[1] T. Uchida, *Proc. Imp. Acad. Tokyo*, **9**, 128 (1933).

## Heavy Water of Crystallisation

THE dissociation pressures of copper sulphate pentadeuterate, $CuSO_4.5D_2O$, as found by a tensimetric method[1], are: at 25° C., $p_1$ = 6·655 mm. Hg.; at 30° C., $p_2$ = 9·285 mm. Hg. From these figures

the heat of combination with liquid deuterium oxide is given by the equation :

$$Q = 4 \cdot 576 \ . \ \frac{T_2 - T_1}{T_2 . T_1} \log \frac{p_2 \mid \pi_2}{p_1 \mid \pi_1},$$

where $\pi_1$ and $\pi_2$ are the vapour pressures of deuterium oxide.

With $T_1 = 298$, $\pi_1 = 22 \cdot 65$ mm. ; and $T_2 = 303$, $\pi_2 = 27 \cdot 934$ mm.[2], this gives $Q = 4{,}437$ gm.cal. This is the value for 2 molecules of liquid $D_2O$ if the reaction is

$$CuSO_4.5D_2O \rightleftarrows CuSO_4.3D_2O + 2D_2O.$$

The corresponding value for ordinary water, $2H_2O$, is 5,560 gm.cal. As would be expected, the value for heavy water is appreciably lower.

Further experiments on this and similar systems are in progress.

J. R. PARTINGTON.
K. STRATTON.

Queen Mary College,
London.
June 5.

[1] NATURE, 137, 707 (1936).
[2] G. N. Lewis and R. T. Macdonald, *J. Amer. Chem. Soc.*, 55, 3057 (1933); NATURE, 132, 248 (1933).

## The Scanning Principle in Television

IN his recent discourse at the Royal Institution[1], Sir Richard Gregory refers to some of the earliest suggestions for systems of television. As perhaps being of some historical interest, I should like to note with regard to scanning—a fundamental principle—that Mr. Llewelyn B. Atkinson in a note, appended to a letter on "Seeing to a Distance by Electricity" in the *Telegraphic Journal and Electrical Review* (Dec. 13, 1889, p. 683), says :

"The idea of using an integrating apparatus for producing the whole image from one element in the time during which the image will remain on the retina was first, I believe, *published* in the *English Mechanic* about 1881 or 1882, and was then, as far as publication goes, new."

The communication thus referred to was entitled "The Telectroscope, or Seeing by Electricity", and appeared under my initials in the *English Mechanic*, April 21, 1882, p. 151.

WILLIAM LUCAS.

9 Shanklin Road,
Crouch End,
N. 8.

[1] NATURE, 137, 981 (1936).

## Points from Foregoing Letters

PROF. J. E. LENNARD-JONES and A. F. Devonshire suggest an explanation of the anomalous reflection and diffraction of helium atoms by lithium fluoride, observed by Frisch and Stern. They show that atoms incident on a solid surface may, under certain conditions, be diffracted *along* and not away from the surface, a process they call 'selective adsorption'. From the observations, they are able to deduce information about the energy levels of adsorbed helium atoms on a lithium fluoride crystal.

The Raman spectrum of the light scattered by sulphur dioxide as a gas, as a liquid and in aqueous solution has been determined by Prof. H. Gerding and W. J. Nijveld. They find a close agreement in the position of the sharper lines of the spectrum of the gas and of the solution, and conclude that the state of the molecules in solution is comparable with that in the free gas.

Prof. E. C. G. Stueckelberg calculates the probability of gamma radiation being formed by the combination of the positive electrons (liberated in certain radioactive changes) with the negative electrons in the outer shell of the atom. He concludes that every emission of positive electrons should be accompanied by weak gamma radiation, but finds that in only one out of 137 cases of decay is gamma radiation emitted.

Diagrams showing the distribution of nuclear spins in atoms of odd mass are submitted by Dr. S. Tolansky. The preponderance of spin of value $\frac{1}{2}$ in the case of nuclei with an odd neutron indicates, according to Tolansky, that neutron spin and orbital moments tend to oppose each other. The author also discusses the relation between nuclear spin and mass defect in atoms of even mass.

E. Pickup directs attention to discrepancies in the calculations of lattice spacings of films containing two crystalline substances, when using the electron diffraction method, as compared with values obtained from X-ray diffraction. These discrepancies and anomalies may invalidate the results of the electron-wave method for measuring atomic constants.

In order to throw light on the mechanism of the reflection of radio waves in the upper atmosphere, C. Th. F. van der Wyck considers the propagation of electromagnetic waves in a vertical direction, when the electric properties of the medium vary in the same direction, and a magnetic field is present making a definite angle with the vertical. He arrives at an expression for the dielectric constant and the conductivity constant of the medium.

Further observations and sketches of the 'line' seen on the surface of slowly moving water when it encounters an obstacle are supplied by Prof. H. Stansfield. He has noticed the phenomenon in a drinking trough, in front of a raft in a pond, where water from a river with a clean surface passes under floating material accumulated at the bars of a grid, etc.

The root of the African plant *Tephrosia macropoda* has a toxic action upon the bean louse *Aphis rumicis*. Dr. J. T. Martin attributes this insecticidal action to the presence of the fish-poisoning compound rotenone and to allied substances which he has isolated from the roots. He believes that a variety of the plant sufficiently rich in these substances could be obtained to be of value in the control of local insect pests.

Dr. S. Smith and G. M. Timmis write that ergosine, a dextrorotatory alkaloid which they recently obtained from ergot, changes on treatment with acids to a lævorotatory isomer, which they propose to call ergosinine.

The appearance in large numbers of sand-worms belonging to the genus *Saccocirrus* at Departure Bay, Western Canada, is recorded by E. Berkeley.

# Research Items

### Nodule Implements

THE late Dr. E. Hugh Kitchin was for some years an assiduous collector of what he considered to be a hitherto undescribed type of flint implement, which he found in gravel pits of the Bournemouth district and of which he had prepared a description at the time of his death ("Nodule Implements in the Bournemouth District". Pp. v+41. Cambridge: W. Heffer and Sons, Ltd. 4s. 6d. net). Search in the gravels of the Canford pit from 1928 onward had produced three types of implements new to the district: a series of flakes similar to those of the Cromer Beach series, rostro-carinates and half a dozen Clactonian cores. In five years 1,030 flakes were collected. Hand axes were also found in the proportion of one to nine flakes. The 'nodule', to which attention was then turned, is a simple nodule of flint, showing some working, chiefly a 'sharpening blow'. In the simplest form there is a single flake-scar at one or other end of the implement. This is invariably on the longest side or edge of the nodule. Thus the axis of the implement is always oblique. The principle of determination is the shape of the nodule—it was naturally suitable for the purpose its maker had in view. The shape therefore is more important than the working, though the proof of the implement is in the combination. The working is usually simple, consisting of sharpening blows, truncating blows, and shaping blows. The sharpening blows are rarely more than three in number. The truncating blows present some difficulty, especially as a naturally truncated flint was used. The shaping blows serve to make the nodule symmetrical. In the examination of a number of specimens the same type of shaping blow will be found to recur again and again. With these implements, familiarity breeds conviction. The Bournemouth pits afford no evidence of age, as implements are found in confusion; but two flints recognised as of the nodule type come from East Anglia, one from the sub-crag at Bawdsey, Suffolk, and one from Forest Bed flints at Cromer.

### Domesticated Sheep

IN a study of the origin of domesticated sheep, Dr. Max Hilzheimer (*Antiquity*, June 1936) points out that as domestication can only have originated where the wild sheep had its home, this at once excludes the whole of Africa. Europe also is eliminated, as the wild breed was extinct before the glacial epoch, a small remnant establishing itself in Corsica and Sardinia, where it is represented to-day by the moufflon. Asia only is left, and there it must have originated in the country lying between the Mediterranean and the Pamirs, though certain Asiatic types may have originated still farther east. With the exceptions noted, the wild breeds are confined to Asia and part of North America. They are not found in the high mountain regions only, as is often assumed, but appear also in the low-lying plains of Central Asia and Siberia, east of the Yenisei to the Polar Sea. The sheep must have been first domesticated in the lowlands around the Caspian and Aral Seas, to the south of the Salt Range in the Panjab, in Baluchistan and in south Persia. It is probable that of the four groups recognised, the Moufflon, the *Vignei*, the Argali and the Bighorns, the first three produced domestic descendants. These vary so much that they already present characters found in the domesticated sheep, but domestication produced even greater variability. In the West, the sheep is among the earliest of domesticated animals. Its remains are found in the neolithic Danish kitchen middens. Mesopotamia shows the near beginnings if not the actual origins of sheep-breeding. In the Jemdet Nasr period there are already three breeds, a fleecy, a broad tail and a hairy sheep. The last-named is probably the most primitive and the most closely related to the wild, as it has not yet developed a fleece. In Egypt the sheep goes back to the second prehistoric culture. The broad-tailed and fat-rumped sheep do not appear to have reached Europe, where the sheep was always of the fleeced variety. Three lines of ancestry are found for the domestic sheep, all to be looked for in Asia: the Asiatic moufflon, the *Vignei* type and the Argali, the last of no importance for European breeds.

### Eelworm Injury of Tomatoes

UP to 1935, the tomato plant was not included in any British list as susceptible to injury by the eelworm *Heterodera schachtii*, but thirty-two cases of such infestation have occurred in Yorkshire since 1928, and a further instance has recently been recorded from Lancashire. Recently, L. R. Johnson and H. W. Thompson have shown that, unless precautionary measures are taken, there is considerable danger that this trouble will become more general, particularly in areas where potato sickness is common, since it is now established that the same strain of eelworm is able to infect both plants (*J. Min. Agric.*, 43, 48). Routine practice of steam sterilisation is undoubtedly the only satisfactory method of treating the soil. Growers who have adopted the cold Dutch house method of tomato culture and who need not remain permanently on the same site, may be unwilling to incur the expense of steam sterilisation; but it is shown that the cost of the sterilising is not much greater than the removal of the house to another site, and only with the former method can one be certain that eelworm-free soil is secured. The difficulty of obtaining uninfected soil is bound to increase with time, particularly as viable potato eelworm cysts have been found in fields that had not carried this crop for ten years, so that it is unsafe to assume that a soil is clean until after a very long period has elapsed.

### Sterility of Droitwich Brine

THE Droitwich brine, used for the Spa treatment, is pumped from a depth of two hundred feet, and is a highly concentrated solution of salts, mostly sodium chloride, amounting to about 2½ lb. to the gallon. According to Dr. Inglis Dawson and Mr. Harold Salt (*Edinburgh Med. J.*, June 1936, p. 402), when pumped the brine is almost sterile, yielding at most one bacterial colony per millilitre. After use in a bath, comparatively few bacteria are present, the brine evidently exerting a bactericidal action. Thus, with

the swimming bath in use for a week without change of water, the bacterial content at the start on the Monday morning was almost nil, and it rose slowly in the course of the week until on the Sunday evening the bacterial content was even then less than 200 per millilitre. Some experiments were also done by inoculating brine with organisms, such as *Bacillus coli*, *Staph. aureus* and *Strep. faecalis*, and determining their fate over forty-eight hours. Starting with many millions of organisms per millilitre, it was found that sterility was attained within twenty-four hours, all the organisms being destroyed by the brine.

### Trend-line of the Himalaya

IN a paper on this subject (*Himalayan J.*, 8; 1936), Mr. D. N. Wadia refers to the similarity and continuity in structure, petrology and stratigraphy in the two flanks of the Himalayan syntaxis in the north-west of India. Around the angle south of the Pamir plateau the rock series on the Kashmir and the Hazara sides show no discordance. This angle was ascribed by Suess to the meeting and conflicting of the Hindu Kush with the Himalayas, with the result that both systems underwent a deflection at the contact. Mr. Wadia, however, supports the view that the explanation is to be found in the folds of the Himalayan geosyncline being moulded on the triangular projection of the resistant shield of peninsular India. The axial continuity of the folds has not been traced far to the west yet, and to the extreme east the continuation is still a matter of conjecture. Mr. Wadia favours the theory that the folds do not extend into China, but turn southward into Burma around the obstruction offered by the former plateau to the west. He holds that the Shan plateau is comparable with the Tibetan plateau and is not traversed by Himalayan folds, which practically go no farther eastward than the Tsangpo gorge. Thus the head streams of the Salwen, Mekong and Yangste flow in trenches longitudinal to the strike of the mountains, and do not cut across the folds.

### Theory of River Flow

NO. 280 of the series "Actualités scientifiques et industrielles" (Paris: Hermann et Cie., 18 francs) is entitled "Hydrodynamique fluviale, régimes variable". It is by Dr. Pierre Massé, who deals with the waves which are propagated along a river or canal when at a point the flow is suddenly augmented for a short time. The form and speeds of the disturbances propagated up and down stream are calculated and are compared with the observations made on the Seine and on the Aar. The principal features of the theory are verified, but not the details, although there are no actual contradictions.

### A Portable Air Velocity Meter

AN extremely convenient portable air velocity meter has been developed by Messrs. Air Conditioning and Engineering Ltd., 4-12 Palmer Street, London, S.W.1. It meets a definite requirement in certain operations upon the mass movements of air, where a portable and robust instrument, giving direct readings over a large range of speeds, is necessary. Most of the accurate methods of determining gas velocities, such as the Pitot tube, U-tube, anemometer, etc., need auxiliaries that tend towards the reverse of portability, and are generally delicate. This instrument, known as the "Alnor Velometer", is entirely self-contained within a small moulded plastic case. It can be stood in the air current, or if more convenient, a rubber tube carrying an exploring jet at the end can be attached to it. The measuring device consists of a vane, upon which the air impinges, balanced against hair control springs, a watch movement and a magnetic damping system. A pointer travels over a scale, behind a glass face, graduated in two ranges 0–250 or 300 and 0–6000 feet per minute. Special scales can obviously be fitted to order. The case is made in three types, with a shutter, orifice, or external tube. The shutter model is simply stood in the air stream, and the shutter manipulated so that the air passes through ports appropriate to its speed. The orifice type has detachable orifices in place of the ports, more suited to high air speeds. The tube type carries a rubber tube with various forms of jets, in the place of the shutter. The jet can thus be moved about and readings can be taken in restricted spaces. Special jets can be designed for cases such as surging currents, readings in enclosed ducts, etc. The meter will work in the reverse direction for suction readings.

### 'Extra' Spots in Electron Diffraction Patterns

V. A. KOLPINSKY, of the Physical Institute, University of Leningrad, writes to point out that the 'extra' spots in a remarkable silver single crystal electron diffraction pattern recently published by L. Brück (*Ann. Phys.*, 26, 254; 1936) can be accounted for in the same way as G. I. Finch and H. Wilman explained the appearance of 'extra' diffractions from graphite (NATURE, 137, 271; 1936). According to this view, these diffractions correspond to fractional Laue orders of normally occurring diffractions, and are due to lattice row periodicities being incompletely developed in one or more directions owing to the thinness of the crystals.

### Reactions of Ammonia with Phosphorus Pentachloride

H. MOUREU and P. Rocquet (*Bull. Soc. Chim.*, 3, 821; 1936) find that the first product of the action of dry liquid ammonia on phosphorus pentachloride is the pentamide, $P(NH_2)_5$. This can lose two molecules of ammonia to form a white amorphous $PN_3H_4$, which polymerises mainly to $(PN_3H_4)_3$ and $(PN_3H_4)_4$, identical with the products of the action of ammonia on the phosphonitrile chlorides $(PNCl_2)_3$ and $(PNCl_2)_4$. On heating, the compound $PN_3H_4$ loses a molecule of ammonia to form phospham, $PN_2H$. Gerhardt, by the action of water on the product of the reaction of ammonia gas with phosphorus pentachloride, obtained a white insoluble phosphamide, $PO(NH)NH_2$, and he postulated the intermediate formation of chlorophosphodiamide, $Cl_3P(NH_2)_2$, which, by the action of heat, gave phospham:

$$Cl_3P(NH_2)_2 = PN_2H + 3HCl,$$

and by the action of water formed phosphamide:

$$Cl_3P(NH_2)_2 + H_2O = PO(NH)NH_2 + 3HCl.$$

Moureu and Rocquet find, however, that their product of the action of ammonia on phosphorus pentachloride is completely soluble in water, and they consider that phosphamide is formed by a secondary reaction, perhaps from $PO(NH_2)_3$ formed from $POCl_3$ and ammonia, the $POCl_3$ being produced by the action of water on $PCl_5$. The hydrolysis of $PN_3H_4$ proceeds quite differently, giving rise to a mixture of a hydrate, $(PN_3H_4)_3.H_2O$, and ammonium tetrametaphosphimate, $(ONH_4)_4P_4N_4O_4H_4$.

# The Electric Supply System of Berlin

IN a paper read to the Institution of Electrical Engineers on May 13, M. W. Davies gave an account of the electric supply system of Berlin and of recent changes and developments that have taken place in it.

Berlin is a rapidly growing city. At the time of the Great War, it was still comparatively small, but was surrounded by a number of satellite towns each possessing its own electric supply system. In 1920 these towns were combined to form Greater Berlin, which is to-day more than half the size of Greater London, and has half its population. It covers an area of 300 square miles and has a population of more than four millions. The average density of the population is almost the same as that of London, but in Berlin the greater part of the population lives in flats, with the result that only 28 per cent of the total area is fully developed. The central district is bordered by lakes and woods covering a further 27 per cent. The remaining 45 per cent is mainly undeveloped country and small holdings. As a result of this concentration, the actual density of the population in central Berlin is very high.

In Great Britain a considerable part of the electric energy sold for domestic purposes is used for heating; but in many parts of the Continent, owing to the extensive use of steam-heating, the development of an electrical heating load is very difficult. In winter, the temperature is often below zero. Most of the flats are equipped with steam central-heating, and so it is not easy to get a satisfactory market for electric cookers and water heaters. Mr. Davies made a special study of the Berlin Power and Light, Co.—known in Germany as the 'Bewag'. He describes how the Company in 1924 attempted to solve the distribution problem for this great industrial city by treating it as a single unit. In 1929 and during subsequent years, this method had to be modified in the light of experience.

The bulk of the electrical power in Berlin is supplied from two large central stations, Klingenberg on the east of the city and Kraftwerk West on the west. A large part of the power for the base load is imported over 100 kv. lines which bring power from two large stations on the lignite field in central Germany. These stations are relics of the War, and are gradually being extended. The only other station of importance is the one at Charlottenburg, which was reconditioned in 1929. It is fitted with pass-out turbines connected directly to a public steam-heating system. In addition, it has Ruths steam accumulators and so can deliver 73,000 k.w.h. per charge at a maximum rate of 50,000 k.v.a.

These steam accumulators are of great value in enabling the system to get over the peak load, which formerly caused some of the lines to be 'tripped' out of the supply. They can be put on to full load in a few seconds and so prevent a stoppage. A 25,000 k.w. steam accumulator is kept constantly on the lines, and furnishes part of the basic load. The average load of the whole system is very high, being 36·2 per cent of the maximum possible. The total consumption of electricity in Berlin is about 350 units per head of the population, which is larger than most other Continental cities.

For local government purposes, Berlin is divided into twenty districts, and sixteen of these are now supplied with electricity by the Bewag. The unification was not a sudden achievement, but was the result of careful planning. The movement started with the pooling of generating resources and was afterwards followed by that highly desirable result, the pooling of common tariffs.

# The Flax Industry in Great Britain

AN interesting account of the history of flax production in Great Britain and the possible line of its development was given by Mr. G. O. Searle at the Annual Conference of the Textile Institute held in London on June 3–5. Though demands are increasing, the production of flax in Great Britain has fallen. In 1864 the total acreage in flax was 320,000, but in 1930 only a tenth of this, since when it has been even lower and rather variable. With the exception of a few hundred acres in East Anglia, flax-growing remains a peasant industry centred in Northern Ireland. Careful selection and breeding has resulted in the production of varieties yielding nearly fifty per cent more fibre per acre than the older commercial seed.

The re-establishment of a flax industry in England depends on changing radically the sequence of processing operations and substituting mechanical methods for manual labour. A flax factory must do more than merely centralise the simple handcraft methods still largely used. Improved methods and new machinery must be developed for the four operations of handling, de-seeding, retting and scutching. Inasmuch as for the last three the flax is required in a thin layer, the expedient of sewing it into mats has been adopted, but this has not as yet been done in the process of harvesting. Such mats greatly simplify the handling of the fibres, and avoid the lifting, untying and re-tying of bundles as at present. The fibres remain in mats during the retting, drying and scutching, a machine for scutching which will take the flax laterally as supplied continuously in the mat, having been developed. With these improvements in processing, the re-establishment of a flax industry in England on a permanent basis is possible.

Various aspects of the question of separating flax fibres from the plant stem were discussed at the Conference by Dr. W. H. Gibson, director of the Linen Industry Research Association. He emphasised the fact that, in the long run, the best results can be efficiently achieved only on the basis of a more profound knowledge of the character of the fibres, and of the tissues in which they are embedded, than

is at present possessed. While much information as to the arrangement of the fibre within the stem has been obtained by microscopic examination, separation depends on the chemical nature of the tissues adjacent to the bundles.

Separation is usually effected by the biological process of retting, but this process is difficult to control and, with the present organisation of the industry in Northern Ireland whereby the grower himself carries out the retting, results in great irregularity in the quality of the flax. A mechanical flax-breaker has just been developed, effectively loosening the ring of fibre bundles from the wood, which may then be knocked out in scutching. If this operation could be carried out by the growers, the partially separated but unretted fibres could be transported cheaply to the flax spinners, who could then treat the fibres so as to obtain a more uniform product.

Chemical retting has been much investigated of recent years and lends itself to proper control. The fibre obtained differs somewhat from biologically retted material, being denser and lighter in colour. At present, mechanical difficulties of handling the flax in the various operations have prevented the large-scale development of chemical retting processes.

By treating the fibres so that they break up into their ultimate fibre strands, flax may be spun on cotton machinery and incorporated in mixed yarns. This 'cottonisation' process may provide an outlet for low-quality flax grown for linseed, and make possible the utilisation of waste flax for the manufacture of high-grade paper.

# Fishery Research in the Eastern Mediterranean*

THE eastern basin of the Mediterranean still offers almost a virgin field for the marine biologists. Apart from such occasional visits as those of the German *Pola* and the Danish *Thor* Expeditions, the main source of information now comes from the Fisheries Research Directorate of Egypt. This Directorate, founded originally as a Fisheries Research Office in 1919 under the direction of Mr. G. W. Paget, has passed through various vicissitudes; but it should now be sufficiently established to prove its value. As in most such undertakings, work of this nature starts from small beginnings. The foundations were well laid by Mr. Paget in his broad surveys of the lake and sea fisheries and his careful study of the sponge grounds; and by his inauguration of a system for the collection of necessary statistics. Special attention was then also paid to the growth and culture of the grey mullets which make up so large a proportion of the catches from the Delta lakes.

Owing to political upheavals, fisheries research lapsed for the period 1924–27. After that time, the office was once more opened under the direction of Mr. R. S. Wimpenny. Research was further developed under his regime, and two important additions were made to the facilities for investigation. A special research vessel, designed on the lines of a modern large steam trawler, H.E.M.S. *Mabahiss*, was completed by Messrs. Swan, Hunter, and Wigham Richardson, and a research laboratory was built near Fort Kait Bey on the eastern harbour of Alexandria. Interesting experiments were also carried out on the transport by air of grey mullet fry to the inland lake Qarûn, which appears to have been successfully stocked. On Mr. Wimpenny's departure at the end of 1931, the direction was taken over by Dr. Hussein Faouzi.

In 1932 the *Mabahiss* was lent by the Egyptian Government for the Sir John Murray Expedition to the Indian Ocean under the leadership of Lieut.-Colonel R. B. Seymour Sewell, and Dr. Faouzi also accompanied the expedition. The experience thus gained should prove of great value to the Directorate, and it is gratifying to see that research is being advanced in another direction by facilities offered to visiting research workers at the Fisheries Laboratory. A distinguished visitor in 1933 was Prof. Adolf Steuer, co-director of the Italo-German Institute of Marine Biology at Rovigno d'Istria, and results of his work and that of a number of specialists are now appearing in the "Notes and Memoirs" published by the Directorate.

The preliminary report on the fishery grounds near Alexandria contains interesting observations on the seasonal sequence of the plankton. There is a big outburst of phytoplankton in September and October which appears to be determined by the Nile flood, and the influence of this water extends over a large area. It has recently been shown by Liebman[1] to affect even the waters of the Palestine coasts, where the planktonic sequence is similar to that at Alexandria. Such observations should have important bearings on the movements of sardines and other fish. A further noteworthy feature is the occurrence of the green algæ, *Caulerpa* and *Halimeda*, down to the fifty fathom line off the Egyptian coast, an index of the excessive transparency of the water.

Another activity of the Fisheries Directorate is the attempt to restock with fish the springs of the Siwa oasis. This is an experiment that will necessarily require careful watching. Preliminary observations have shown that the bolti (*Tilapia*) which are being used do not feed on the cyprinodonts reared to feed on mosquito larvæ, but do feed on the latter. It is to be hoped that they do not change their habit and repeat the effects of the previous introduction of an ill-judged species which devoured the cyprinodonts so carefully inserted by the Department of Hygiene.

Now that research is on so sound a footing, the Egyptian Government should see grounds for fostering and furthering investigations in this most interesting region. There can be no doubt that knowledge so gained will prove of immense value in predicting and controlling the extent of the fisheries.

F. S. RUSSELL.

* Rapport sur les Pêcheries d'Egypte en 1932. Par Ibrahim Abd-El-Galil Abou-Samara. Direction des Recherches des Pêcheries. Administration des Gardes-Côtes et des Pêcheries. Ministère des Finances. Le Caire, Imprimeries Nationale, Boulac 1935.

The Fishery Grounds Near Alexandria. (1) Preliminary Report. By Adolf Steuer. *Ibid.* Notes and Memoirs No. 8, 1935. (2) A Bottom Sample taken at Alexandria. By Aristocle Vatova. No. 9. (3) Cirripeda. By Hjalmar Broch. No. 10. (4) Some Marine Mites from Alexandria. By Karl Viets. No. 11. (5) Ostracoda. By Walter Klie. No. 12.

[1] Oceanographic Observations on the Palestine Coasts. By E. Liebman. Comm. Int. Explor. Sci. Mediterr., *Rapp. Proc. Verb.*, 1935.

## Magic and Medicine in Early England

PROF. CHARLES SINGER, professor of the history of medicine in the University of London, delivered the Fison Memorial Lecture in the anatomical theatre of Guy's Hospital Medical School on June 18. The subject of the lecture was "Magic and Medicine in Early England".

Prof. Singer pointed out that there must have been a mass of magico-medical material of combined Celtic and Roman, Pagan and Christian origin in use in England before the advent of the Anglo-Saxon culture. This early material has almost entirely disappeared; only faint traces of it have been recovered by folk-lorists in any recognisable form. Early Celtic elements have disappeared almost entirely even from the manuscript texts. Considering the labour that has been put into it for over a century, the results of folk-lore research in England are very disappointing and singularly destitute in positive results. Most so-called 'native' folk-lore is part of the general European heritage and strongly coloured by Roman civilisation and Roman Christianity. In so far as English folk-lore is medical, it is largely in line with and probably derived from the herb-lore of Salerno in southern Italy. That town, of mixed Latin, Greek and Saracen culture, was the purveyor of such material to Europe throughout the Middle Ages at least from the tenth century onward. The leech books that have come down to us from Anglo-Saxon times, however, whether in Latin or in the Anglo-Saxon language, contain a certain amount of material of distinctive character, some of which is of genuinely early and even of pagan origin. In these early leech books magical and simple herbal remedies are inextricably mixed. The Anglo-Saxon leech books are largely commonplace books in which, from time to time, supposedly useful recipes, both for men and beasts, were jotted down.

There has been some discussion as to who were the men who used, read and wrote these books. At least some of the leech books were certainly not produced nor could they have been used by priests. For the administration of many of the remedies, the prescriptions specifically state that a priest must be called in. Some few of the magical devices are of obviously pagan tone and it is most unlikely that they were either written or used by anyone in orders. There are a considerable number of representations of leeches in Anglo-Saxon art and these never show the tonsure. It is probable that the Anglo-Saxon leeches were men of the yeoman or farmer class who combined with their calling a hereditary knowledge of leechcraft much as was the case until quite modern times in certain families in Wales and the Gaelic-speaking highlands of Scotland.

There are in all about twenty manuscripts of Anglo-Saxon origin and of magico-medical interest. Practically all are in the libraries of the British Museum, the Bodleian and Corpus Christi College, Oxford and the preservation of most of them is due to the foresight exhibited in the sixteenth century by Sir Robert Cotton and Archbishop Parker.

As regards the actual remedies in the leech books, the overwhelming majority represent corrupted and misunderstood classical medicine of Greek origin from which, however, all rational elements and all theoretical considerations have almost wholly departed. A certain amount consist of direct translation of Salernitan material. Ecclesiastical elements are strong throughout and many remedies are suggested by or are modelled on the ceremonies of the Church. Wandering Syrian traders and Celtic missionaries or Italian priests must have been introduced, for tags of Irish, Byzantine and Syriac theurgy are traceable here and there. In several places a few words of Greek, Irish, Syriac and Hebrew are recognisable and a number of 'Pythagorean' charms have survived which use misunderstood Greek letters. Among the strangest survivals of all is a Hebrew alphabet which accords to the Samaritan type, and is to be found in an Anglo-Saxon manuscript in Exeter Cathedral library.

The leech books provide evidence for some direct traffic in Anglo-Saxon times between south Italy and England. Apart from the Salernitan elements, there is evidence of direct copying of figures from that source. Some of the Anglo-Saxon leech books are handsomely illustrated by figures of plants, and it can be shown that many of these represent Mediterranean and not British forms. Again, a number of representations of the scorpion—a favourite theme in these manuscripts—are obviously copied from the work of artists who were familiar with this part of southern Europe.

Among the magical spells in the leech books are a few exhibiting pagan Saxon elements. In almost all of these there has been a systematic attempt to Christianise the original form. In one, however, of about 1100 or a little later, the name of the god Woden has been allowed to stand. Thus traces of an almost open paganism must have survived in England at least as late as the twelfth century.

Perhaps the most curious of all the pagan survivals, and one which lasted well into Norman times, is a group of Latin prayers addressed to the pagan classical 'Queen of Heaven'. Owing to the somewhat obscure wording this deity was evidently mistaken for the Virgin.

Despite the persistence and interest of these traces of paganism, there can be no doubt that pagan elements, whether classical Anglo-Saxon, Celtic or other are very few and unimportant. The material and spirit of the early English leech books are overwhelmingly Latin and Christian and all other elements are obviously rapidly receding.

## Educational Topics and Events

CAMBRIDGE.—The Anglo-American Corporation of South Africa, the Central Mining and Investment Corporation, the Consolidated Goldfields of South Africa, the New Consolidated Goldfields and the Union Corporation have each made a donation of £1,000 to the Cavendish Laboratory.

Miss G. L. Elles of Newnham College has been appointed reader in geology. R. F. Kahn of King's College has been appointed University lecturer in economics, C. W. Gilbert of Jesus College, University demonstrator in physics, Dr. E. C. Childs of Clare College, University demonstrator in soil science, C. H. Waddington of Christ's College, University lecturer in zoology, D. H. Valentine of St. John's College, University demonstrator in botany and Dr. G. A. Millikan of Trinity College, University lecturer in physiology. H. P. Whiting of Queens' College has been appointed assistant to the Director of the Museum of Zoology.

LONDON.—Mr. H. L. Eason has been re-elected Vice-Chancellor for the year 1936–37.

Dr. G. C. McVittie has been appointed as from October 1 to the University readership in mathematics tenable at King's College. Since 1934 he has been lecturer in applied mathematics in the University of Liverpool.

Dr. W. V. Mayneord has been appointed as from July 1 to the University readership in physics tenable at the Royal Cancer Hospital (Free). Since 1927, he has been physicist to the Radiological Department of the Hospital.

OXFORD.—The Curators of the University Chest have been authorised to receive from the Rockefeller Foundation a sum not exceeding £1,600 annually for five years from October 1. 1936, for researches in the Dyson Perrins Laboratory on the synthesis of proteins.

Mr. G. J. Whitrow has been appointed to a 'lectureship' (the equivalent of a research fellowship) in mathematics at Christ Church. Mr. C. S. Elton, director of the Bureau of Animal Population in the Department of Zoology, has been elected a research fellow of Corpus Christi College.

A full professorship in social anthropology has been created in the place of a readership, and application for the chair should be made before September 19. The new professorship will be attached to All Souls College.

SHEFFIELD.—The following appointments have been made: Dr. A. E. Barnes to be professor of medicine, in succession to Prof. A. E. Naish; Dr. H. W. Swift to be professor of engineering. Mr. R. G. Bellamy and Dr. J. Dick, assistant lecturers in mechanical engineering, have been made lecturers.

## Science News a Century Ago

### The Faraday Dark Space

IN 1836, Faraday began those experiments on the electric discharge which form part of his researches in electrostatics, and which are described in the Twelfth and Thirteenth Series of his Experimental Researches in Electricity. At first he examined the nature of the brush and spark discharges from balls and points in air, and the influence of shape, separation and other factors on the discharge between two opposed electrodes. Afterwards, he had a glass globe constructed, with openings at opposite sides through which brass electrodes could be passed, and with a third opening and stopcock for connexion to an air pump. This apparatus, with which he intended to examine the discharge or arc between the electrodes in air and gases at low pressures, was first brought into use on June 21. After some preliminary experiments, described in the "Diary", he writes:

"The ends within the globe were brought in contact—the globe exhausted thoroughly—and a continuous current at the conductor used. On opening the ends, gradually a peculiar and constant appearance of great beauty was observed. At the moment of separation, a glow of light came over the end of the *negative* wire, the positive being dark. As the distance increased, a purple stream or haze went right out from the end of the P. wire towards the N. end; this elongated as the distance increased, but there was *always a dark space between the end of it and* the haze on the N. wire. The space was nearly invariable in its width and also its position relative to the N. wire, nor did the glow on the N. end vary. It was curious to see the P. purple haze diminish or lengthen as the wires were separated: and the dark space is *probably an important point to understand.*"

Thus Faraday described for the first time the beautiful appearances in an exhausted discharge tube which afterwards on many occasions excited his admiration, and recorded his first observation of the dark space, now so well known, which bears his name.

### Communications in South Africa

AT a meeting of the Royal Geographical Society held on June 27, 1836, a paper by Major Mitchell was read entitled "On the Roads and Kloofs in the Cape Colony". Major Mitchell was the Surveyor at the Cape of Good Hope, and in its report of his paper, the *Athenæum* said: "The vast importance of our colonial possessions in Southern Africa, covering an extent of territory equal to the whole British Isles, gives great interest to any information tending to facilitate communication. A range of mountains running parallel to the western and southern coasts at a distance of about 40 miles from the sea, forms a barrier cutting off communication with the interior, which can only be traversed at certain mountain passes which retain the Dutch name of kloofs. In the western range there are nine of these mountain passes, in most of which it is necessary to take a waggon to pieces, carry it and its cargo piece-meal through and then put it together and re-load; yet, if a good road were constructed at Nostert's Hoch Pass, which might be done, Major Mitchell said, for £8,000, there would be no absolute necessity for any other in the range. In Major Mitchell's view, if Government would expend £20,000 on making roads and bridges in Cape Colony, no further outlay would be required for two centuries to come, by which time the colony would be fully equal to provide for itself."

### The Reorganisation of the British Museum

ON June 28, 1836, *The Times* published a note on the British Museum saying: "The Committee of the House appointed last session to inquire into the affairs of this establishment with a view to extend its public utility has, we understand, nearly concluded its labours: and we congratulate our readers on the probability of their receiving some substantial benefits from the contemplated alterations in the government and arrangements of the national museum. We trust that our manufacturers will not, hereafter, be compelled to send to France for patterns for their workmen, it being the intention of the Government among other improvements, to establish a School of Design, to form an integral part of the British Museum, which cannot fail, in course of time to obviate the unpleasant necessity of applying to our neighbours, and greatly to promote the success of our arts and manufacturers. . . . With regard to the Museum Inquiry, we understand, that for whatever benefits the public may derive from it, they are chiefly indebted to Mr. John Millard, who for the last three years has devoted the greater part of his time and attention to the subject." On July 2, *The Times* published a letter from R. T. Stothard, who claimed that the improvement of the British Museum for the last eight or ten years had been the subject which "had occupied every moment of his leizure hours".

# Societies and Academies

## DUBLIN

Royal Dublin Society, May 26. Report of the Radium Committee for the year 1935. Records are included of the treatment of 451 cases of malignant disease and 149 cases of non-malignant disease with radon supplied by the Society's laboratory. The chief feature of interest is the tendency towards the use of larger doses, the average activity of each capillary issued having risen from 5·1 millicuries in 1934 to 6·5 in 1935, and the average quantity of radon issued per case being 27·6 as compared with 19·9 in 1934. Many successful results are recorded, especially in cases of surface disease. KENNETH C. BAILEY and W. E. CALCUTT: The inhibition of chemical reactions (6). The influence of ether and nitrobenzene on the absorption of ethylene by sulphuric acid. The rate of absorption of ethylene by sulphuric acid is diminished sharply by the presence of small quantities of ether or nitrobenzene, both of which are positively adsorbed at the surface of the acid. This retarding effect is very much smaller if the surface of the acid is moving too rapidly for the surface-active retarder to accumulate there. The kinetics of the reaction have been examined, and lead to relationships between the efficiency of the retarders and their concentrations at the surface of the sulphuric acid. No relationship was found with the concentrations in the bulk of the liquid. The retarders probably act at the gas-liquid interface. A. FARRINGTON: The glaciation of the Bantry Bay district.

## PARIS

Academy of Sciences, May 18 (*C.R.*, **202**, 1629–1724). GABRIEL BERTRAND and ANTON PHILIP WEBER: The combined action of folliculin and certain mineral catalysts on the development of a yeast. The joint action of hormone and mineral catalyst on the development of the yeast *Rhodotorula glutinis* var. *Saitoi* was examined. Whilst folliculin alone increased the yield from 12 to 16 per cent, and zinc alone 10 per cent, their joint action increased the yield 79–150 per cent. LUCIEN DANIEL: Variations of the decapitated dandelion. LUBOMIR TCHAKALOFF: A generalisation of Rolle's theorem for polynomials. E. J. GUMBEL: The distribution of compatible events. L. ERMOLAEV: Study of a correspondence between curves and surfaces. ANDRÉ KOLMOGOROFF: Relative cycles. The theorem of duality of M. Alexander. NATAN ARONSZAJN: *N*-dimensional homotopy. TIBÈRE POPOVICIU: A problem of the maximum of Stieltjes. KARL MENGER: Minimising non-rectifiable curves and general fields of curves admissible in the calculus of variations. CHARLES PLATRIER: The problem of Barré de Saint-Venant for a homogeneous, non-isotropic, imperfectly flexible body. EMILE JOUGUET: Remarks on the preceding communication. ALBERT GRUMBACH: The variable period of flow of a liquid in an indefinite capillary tube. VICHNIESKY: The relation between the vibratory phenomenon accompanying detonation, the period of increase of pressure and the value of the maximum pressure during the combustion in an internal combustion motor. MLLE. GEORGETTE DE NOCKERE: The analytical representation of the lunar relief. JEAN HÉLY: A synthetical theory of gravitation and of electromagnetism. LOUIS ROUTIN: An automatic repeater designed for the physical cultivation of the memory. LUCIEN DELAVENNA and JEAN MAILLARD: The electrolytic oxidation of sodium chloride into sodium chlorate. The modified method proposed avoids production of chlorine, is free from the danger of detonating gas, gives hydrogen capable of utilisation, and furnishes crystalline sodium chlorate of 99·5 per cent purity. MLLE. SUZANNE VEIL: Electrometric potential and concentration of the electrolytes. MLLE. CÉCILE STORA: The influence of *p*H on the Becquerel effect of coloured electrodes. MME. RENÉE HERMAN-MONTAGNE, LEWI HERMAN and RAYMOND RICARD: Photographic photometry in the extreme ultra-violet. J. M. BAČKOVSKÝ: A method of obtaining soft X-rays in the case of gases, particularly the *K* spectrum of neon. EDOUARD TOPORESCU: The depolymerisation of water by capillarity and the inversion of sugar. MME. MARIE FREYMANN: Comparison of the infrared absorption spectra and the Raman spectra of some primary fatty and aromatic amines. MLLE. MARIE THÉODORESCO: The study by the Raman effect of two borotartaric complex compounds in solution. GEORGES LÉVY: The sulphonation of β-ethylnaphthalene. The synthesis of 2-ethyl-6-naphthol. JEAN VÈNE: Preparation of monoalkyl and monoaryl substitution derivatives of β-campholide and of the corresponding acid δ-alcohols. PIERRE PASTUREAU and MLLE. MARGUERITE VEILER: Some boric esters of substituted glycerols. JEAN DÉCOMBE: The preparation of β-chlorethyl ketones and β-vinyl ketones. LOUIS ROYER: The orientation of crystals of potassium fluoborate by mica and barytes and of crystals of sodium sulphite by mica. GEORGES JOURAVSKY: The chemical composition of the titanomagnetites. MAURICE BREISTROFFER: The stratigraphy of the middle Cretaceous in Chartreuse. GILBERT MATHIEU: The coal measure fragments of Ville-Dé-d'Ardin and of Fougeroux (Deux-Sèvres). HENRY HUBERT: The limits of the aerial currents in West Africa. MAURICE QUENDIAC: The solubility of the tannic compounds of chestnut wood. MAURICE HOCQUETTE: Elaboration by the secreting cell and the phenomena of secretion in *Primula obconica*. GILBERT RANSON: The so-called degenerescence of *Navicula fusiformis* (*N. Ostrearia*). ALBERT DEMOLON and ANTOINE DUNEZ: The fatigue of soils. Cause and remedies. PH. JOYET-LAVERGNE: The role of the cytoplasm of the male gamete in the phenomena of fecundation. RAOUL LECOQ and JOSEPH M. JOLY: The influence of disturbed food equilibrium on the respiratory quotient and basic metabolism of the pigeon. MLLE. N. CHOUCROUN: Superficial electrification, a specific character of micro-organisms. ANDRÉ BADINAND: Modifications of function of ascorbic acid, as an activator of hepatic catepsine, under the influence of metals added either in ionisable form, or forming part of complex derivatives of vitamin C. MLLE. IRÈNE KOPACZEWSKA and W. KOPACZEWSKI: The plurality of zones of flocculation and of seric gelatinisation. ALFRED BOQUET and ROGER LAPORTE: Experimental serofibrinous pleurisy by intra-peritoneal inoculation of bovine tubercle bacilli of the smooth dyagonic type. MME. ANDRÉE ROCHE, MARCEL DORIER and LOUIS SAMUEL: The meaning of the ratio albumen to globulin, in normal and pathological human serum.

### MELBOURNE

Royal Society of Victoria, April 16. A. B. EDWARDS: Occurrence of quartz-tourmaline nodules in the granite of Clear Creek, near Everton. Nodules composed essentially of quartz and blue tourmaline occur, associated with aplite. The tourmaline has replaced the orthoclase of the granite *in situ*. They seem best explained as originating from bubbles of boron that have risen into the semi-crystalline, viscous upper part of the granitic magma as a result of some sudden release of pressure, and have reacted with the orthoclase crystals when the temperature of the granitic magma has decreased sufficiently. The nodules constitute about one per cent of the granite, which is equivalent to about 1·5 tons of boron per 100,000 tons of granite, or 0·05 per cent of $B_2O_3$. EDWIN SHERBON HILLS: Physiographic history of the Victorian Grampians. For thirty years, Victorian physiographers have accepted, without question, Hart's view that the Grampians are typical block mountains, deriving their topographic form from Tertiary fault movements. Physiographical and stratigraphical investigations of critical localities indicate, however, that the Grampians owe their relative elevation to the resistance to erosion of the massive sandstones of which they are dominantly composed.

### MOSCOW

Academy of Sciences (*C.R.*, 1, No. 9, 1936). N. A. ACHYESER and M. KREIN: Two problems of the minimums connected with the problem of moments. A. DANILEVSKIJ: A theorem by M. G. Krein. M. J. DEISENROTH-MYSSOWSKY, G. D. LATYSCHEV, L. I. RUSSINOV and R. A. EICHELBERGER: The problem of boron disintegration by means of slow neutrons. B. MOLDAVSKIJ and H. KAMUSCHER: Catalytic cyclisation of carbohydrates of the fat series. B. S. BUTKEVICH and L. K. OGNICKAYA: Role of formic acid in the biochemical formation of oxalic acid. N. A. ILJIN: Experimental moult in animals which do not moult naturally. A moult in the normally non-moulting races of merino sheep can be induced by introduction into the organism of certain chemical substances. This suggests that the genetic difference between the two groups of races is less fundamental than it appears. A. ZAVARICKIJ: Lavas of the volcanoes in the environs of Merghen, Manchuria.

(*C.R.*, 1, No. 6, 1936). M. KURENSKIJ: A method for the solution of the problem of deformation of surfaces. N. KALABUKHOV: The internal photo-effect in potassium chloride under illumination with ultra-violet light. A. FILIPPOV, J. LARIONOV and A. SEIDEL: The fluorescence of terbium salts in solutions. M. F. NEUBURG: Discovery of sapromixite on the Tomi River, Kuznetsk basin. I. A. REMESOV: The synthesis of $\Delta^4$-dehydro-androsterone ($\Delta^4$-3-oxyethyocholenone-17) produced directly from cholesterine. F. F. MAZKOV: A new rapid method for the recognition of the living, dead and injured tissue of a green plant. When soaked in weak solution (0·1–0·3*N*) of hydrochloric acid for 15–20 minutes, living tissue remains green, the dead becomes brown, and the injured spotted with brown. I. STRELNIKOV: Water metabolism and diapause in *Loxostege sticticalis*. Diapause can be induced by dry food, by food of high nutritional value, and by low temperature. L. V. POLZHAJEV: Regulation of primordial eye and induction of the lens from epithelium.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Tuesday, June 30

WARBURG INSTITUTE, at 5.30.—Dr. E. A. Lowe: "Roman Culture before and after the Carolingian Reform as reflected in Latin Manuscripts".*

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CHEMICAL ENGINEERING CONGRESS OF THE WORLD POWER CONFERENCE, June 22–27.—To be held in London.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, June 30–July 4.—Annual Congress to be held in Oxford.

June 30, at 8.30.—Prof. G. D. Hale Carpenter: "Charles Darwin and Entomology" (Presidential Address).

INTERNATIONAL CONGRESS ON GLASS, July 2–11.—To be held in London and Sheffield.

July 3, at 4.30—(at the Institution of Electrical Engineers, Savoy Place, London, W.C.1).—Dr. J. C. Hostetter: "The Casting of the 200-inch Telescope Disc".*

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## Official Publications Received

### Great Britain and Ireland

British Chemical Plant, 1936: the Official Directory of the British Chemical Plant Manufacturers' Association. Pp. 140. (London: British Chemical Plant Manufacturers' Association.) [285

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 1, No. 3: Studies in Clocks and Time-keeping, No. 5: The Suspended Chronometer. By Prof. R. A. Sampson. Pp. 13–25. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. [295

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1668 (Strut. 248, 298): Abstract—Stress-Calculation in Frameworks by the Method of "Systematic Relaxation of Constraints", 1, 2 and 3. By R. V. Southwell. Pp. 2. 2*d*. net. No. 1671 (Strut. 258): Flexural and Shear Deflections of Metal Spars. By I. J. Gerard and H. Boden. Pp. 13+1 plate. 9*d*. net. No. 1676 (I.C.E. 917, 996): Abstract—Ice Formation in Carburettors. By W. C. Clothier. Pp. 2. 2*d*. net. No. 1678 (F.M. 234): Lamina Boundary Layer on the Surface of a Sphere in a Uniform Stream. By S. Tomotika. Pp. 14+5 plates. 1*s*. net. No. 1680 (1202): Abstract—On the Synthesis and Analysis of Simply-Stiff Frameworks. By Dr. H. Roxbee Cox. Pp. 2. 2*d*. net. (London: H.M. Stationery Office.) [66

### Other Countries

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 16: Elementary School Graduating Examinations. By David Segel. Pp. v+64. 10 cents. Pamphlet No. 64: Significant Programs of High-School Parent-Teacher Associations; a Study of Current Practices in a Selected Number of Associations. By Ellen C. Lombard. Pp. 42. 5 cents. Pamphlet No. 66: Education of Teachers; Selected Bibliography, June 1, 1932, to October 1, 1935. By Benjamin W. Frazier. Pp. vi+42. 5 cents. Pamphlet No. 67: Training of Elementary Teachers for School Health Work. By Dr. James Frederick Rogers. Pp. iii+27. 5 cents. Pamphlet No. 68: What every Teacher should know about the Physical Condition of her Pupils. By Dr. James Frederick Rogers. Pp. 30. 5 cents. (Washington, D.C.: Government Printing Office.) [275

University of California Publications in American Archæology and Ethnology. Vol. 36, No. 3: Wappo Ethnography. By Harold E. Driver. Pp. iii+179–220. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1936.) 2*s*. 3*d*. net. [275

U.S. Department of Agriculture: Bureau of Entomology and Plant Quarantine, Division of Insecticide Investigations. Lonchocarpus Species (Barbasco, Cube, Halari, Nekoe and Timbo) used as Insecticides. By R. C. Roark. Pp. 133. (Washington, D.C.: Government Printing Office.) [285

Proceedings of the American Academy of Arts and Sciences. Vol. 71, No. 1: A study of the Nolanaceæ. By Ivan M. Johnston. Pp. 87. 1.45 dollars. Vol. 71, No. 2: Revision of the Nearctic Raphidiodea (Recent and Fossil). By F. M. Carpenter. Pp. 89–157+2 plates. 1.20 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [285

Brooklyn Botanic Garden. Memoirs, Vol. 4: Twenty-fifth Anniversary Papers presented May 15, 16, 1935. Pp. xiii+133+2 plates. (Brooklyn, N.Y.: Brooklyn Botanic Garden.) [285

National Research Council of Japan. Report, Vol. 2, No. 4, April 1934—March 1935. Pp. ii+245–345. (Tokyo: National Research Council of Japan.) [295

N.Z. Department of Scientific and Industrial Research. Christchurch Magnetic Observatory: Annual Reports for 1931, 1932, 1933. Pp. xviii+132. (Wellington: Government Printing Office.) 10*s*. 6*d*. [26

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 30: The Effects of Storing Cotton Bales in the Open and inside a Shed at Karachi. By Dr. Nazir Ahmad. Pp. ii+24. (Bombay: Indian Central Cotton Committee.) 8 annas. [25

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